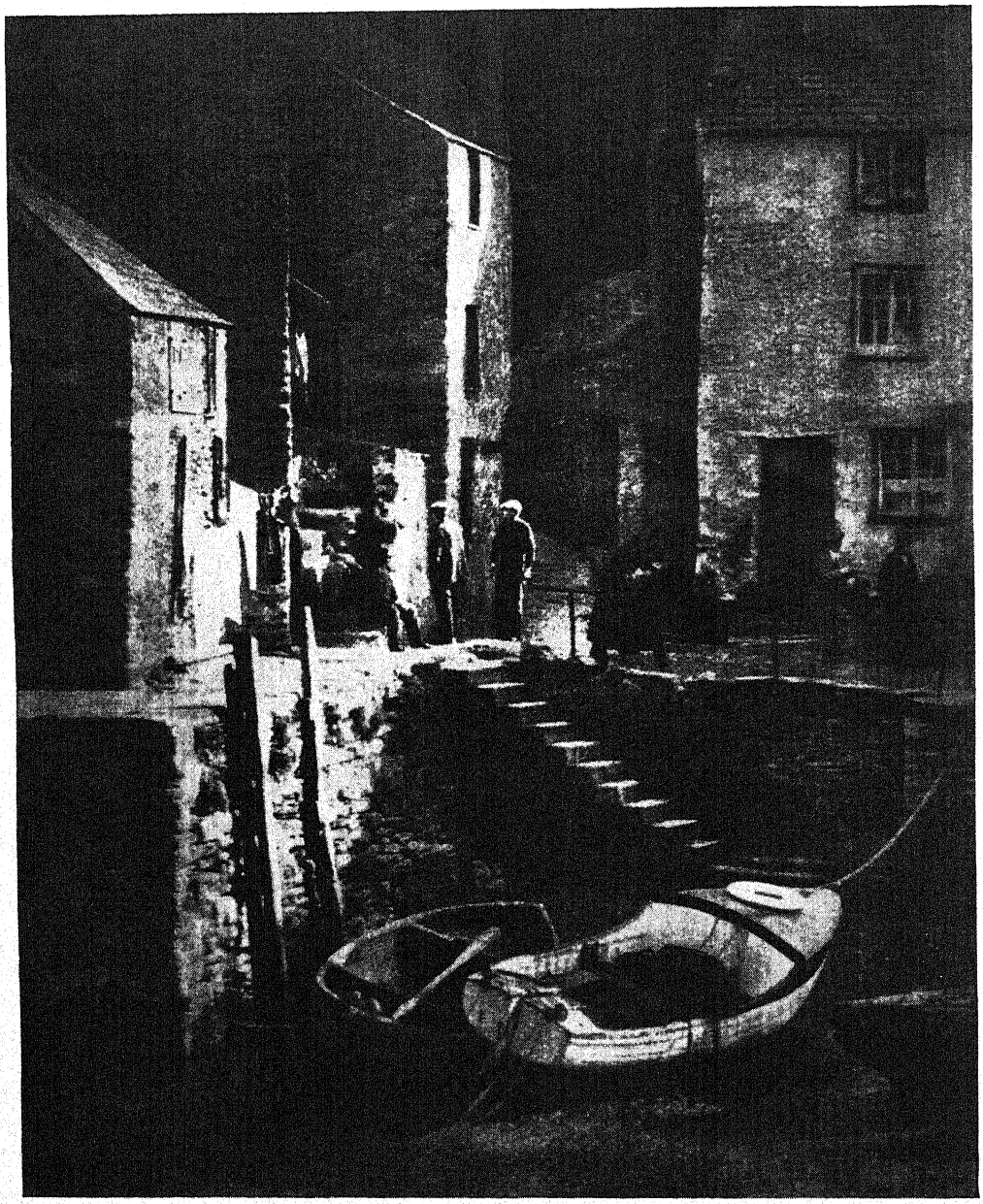
The MODERN ENCYCLOPEDIA of PHOTOGRAPHY



THE HARBOUR

by G. L. Hawkins, M.C., F.R.P.S.

THE MODERN ENCYCLOPEDIA OF PHOTOGRAPHY

A Standard Work of Reference for
Amateur & Professional Photographers

CENTRAL ARCHAEOLOGICAL LIBRARY New Delhi

General Editor

S. G. Blaxland Stubbs

General Editor, Waverley Technical Encyclopedias

Associate Editors

F. J. Mortimer, Hon. F.R.P.S.

Editor of 'The Amateur Photographer' and 'Photograms of the Year'

Gordon S. Malthouse

Editor of 'Amateur Cine World' and 'Miniature Camera World'

4395

R 770.3
M.E.P.

VOLUME 1

Aberration—Epidiascope

American Photographic Publishing Co.
Boston, Mass. C-1938.

RAL ARCHAEO
BRARY, NEW DE
No. 4395
6. 4. 56
all No. R770.3/M.E.P

Printed in England by The Amalgamated Press, Ltd., London, S.E.1

LIST OF FINE ART PLATES: VOLUME ONE

	Page
The Harbour, *G. L. Hawkins, M.C., F.R.P.S.*	*Frontispiece*
The Skier, *M. Le Coultre*	17
Painting the Mast, *S. J. Kharegat*	18
Joie de Vivre, *R. G. Lewis*	19
The Cart on the Cobbles, *John H. Ahern, F.R.P.S.*	20
Jumping a Crevasse, *Donald McLeish*	37
The Port of London, *Daily Mirror*	38
Trafalgar Square—A Wet Night, *L. Pritchard*	39
Advertising Photography—A Mannequin, *Studio Sun, Ltd.*	40
Angel Fish, *Bernard Alfieri, Jr.*	97
Foxes at their "Earth," *Oliver G. Pike, F.R.P.S.*	98
Bathing Girl, *Cecil D. Notley*	99
Lott's Cottage, Flatford, *L. A. B. Edenborough*	100
Domestic Interior, *Dr. Paul Wolff*	133
The Artist	134
Home From School, *J. F. Cutler*	135
Harvest End, *Maurice H. Disney*	136
Old Lambeth Bridge, *F. J. Mortimer, Hon. F.R.P.S.*	201
Nature's Design, *W. G. Briggs, F.R.P.S.*	202
Kestrel Brings Field Vole to Young, *Eric J. Hosking*	203
The Mystic, *H. B. Burdekin*	204
The Crossing, *John Ahern, F.R.P.S.*	237
Soap-Bubbles, *Kodak, Ltd.*	238
Alexander, *D. E. Layard*	239
Old Cottage at Bignor, Sussex, *B. Chambers, F.R.P.S.*	240
The Bridesmaid, *Marcus Adams, F.R.P.S.*	289
In An Old Yard, *Charles F. Lonsdale*	290
Start	291
Misericord at Ripon, *Dr. K. I. Johnstone, A.R.P.S.*	292
'Hello!' *W. K. Chadburn*	437
Holiday, *Robert Bagby*	438
The Rocky Coast of Ibiza, *Baron Mario Bucovich*	439
Nude, *C. Wyman*	440
Fair Weather, *E. Haigh*	489
Little Man, *N. Ashmore*	490
Evening Shadows, *H. Walther*	491
Ballet Scenes, *Peggy Delius, A.R.P.S.*	492
Young Raleigh, *Edward Bishop*	541
Noon Sunlight, *Albert Wallis*	542
Pals, *Jack Barsby*	591
Thaw, *John T. Knight*	592
And So To Bed, *C. Ilott*	592
I Was There, *Albert Towers*	593
Boat on the Thames, *Leo A. Leigh, A.R.P.S.*	594
The Three Fishers, *F. J. Mortimer, Hon. F.R.P.S.*	643
A Stream in Oxshott Woods, *R. Douglas Paul*	644
Looking Back, *F. J. Zenas Carter, A.R.P.S.*	645
The Street Musician, *Mme. Yevonde*	646

REPRODUCTIONS OF COLOUR TRANSPARENCIES AND COLOUR PRINTS

	Facing page
Natural Colour Photographic Print, *D. A. Spencer, Ph.D., D.I.C., F.R.P.S.*, Vivex One-Shot Camera	117
Colour Transparencies by Subtractive Processes :	
Kodachrome, *A. K. Rittener, A.R.P.S.*	356
Agfacolor, *Bernard Alfieri, Jr.*	356
Modern Colour Photography : The Principles Shown in Diagram Form—Additive Colour Processes, Subtractive Colour Processes, Paper Printing Processes	357
Colour Photography—An Example of an Additive Process, Finlay Colour, Ltd.	370
Minehead Harbour—From a Dufaycolor Transparency, *G. H. Fletcher*	392
Eastman Wash-Off Relief Print, *Bernard Alfieri, Jr.*	392
Two Examples of Colour Printing (Paper) Processes :	
Chromatone (Toning) Process, *J. H. Coote*	393
Duxochrome (Pigment) Process, *Dr. Hans Sarnow*	393

PRINCIPAL ARTICLES IN VOLUME 1

Introductory Article: (1) **Triumphs of Modern Photography,** *F. J. Mortimer,* Hon. F.R.P.S.
Editor of "The Amateur Photographer," "Photograms of the Year," "The Dictionary of Photography," by E. J. Wall, F.R.P.S.

Introductory Article: (2) **Modern Magic of the Amateur Cine Camera,** *G. S. Malthouse*
Editor of "Amateur Cine World" and "Miniature Camera World"

How Your Camera Works

Advertising Photography in the Modern World, *E. Searle Austin*
Editor of "Advertising Monthly"

Aerial Photography, *F. L. Wills,* F.R.P.S., F.R.S.A.
Author (with C. Winchester) of "Aerial Photography," Founder and Director of Aerofilms, Ltd.

Alpine Photography Above the Snowline, *Donald McLeish*

Animal Photography, *Arthur R. Thompson,* F.L.S.
Author of "Nature by Day," "Nature by Night"

Aquarium Photography, *Bernard Alfieri, Jr.*

Archaeological Photography in Field and Studio, *D. S. Lyon*
Of the British Museum Photographic Studio

Architectural Photography, *David Charles,* F.R.P.S.
Author of "Brighter Photography," "Home Photography: How to do Your Own Developing"

Art in Photography, *W. L. F. Wastell,* Hon. F.R.P.S.

Artificial Lighting for Indoor Photography, *Bernard Alfieri, Jr.*

Cinematography, Artificial Lighting

Astronomical Photography for Amateurs, *H. H. Waters,* F.R.S.A.
Author of "Astronomical Photography for Amateurs"

Autumn With The Camera

Colour Photography in Autumn

Autumn Lighting, Cinematography

Backgrounds, *David Charles,* F.R.P.S.

Beginners: Hints and Tips

Bird Photography With a Still Camera, *Ian Thomson,* F.R.P.S.
Author of "Birds from The Hide"

With a Miniature, *W. B. Redmayne*

With a Cine Camera, *G. L. Hawkins,* F.R.P.S.

Box Camera

Bromide Papers and Their Characteristics, *F. J. Mortimer,* Hon. F.R.P.S.

Bromide Printing, *F. J. Mortimer,* Hon. F.R.P.S.

Bromoil: Pigment Process Explained, *F. J. Mortimer,* Hon. F.R.P.S.

Cameras for General and Special Purposes, *J. E. Saunders,* F.Z.S.
Assistant Editor of the "Photographic Journal"

One-Shot Cameras For Colour Photography, *J. H. Coote*

Care of The Camera

Carbon Process for Contact Printing, *B. Chambers,* F.R.P.S.
Of the Autotype Co., Ltd.

Carbro Process for Printing from Bromides, *B. Chambers,* F.R.P.S.

Cat Photography, *Thomas Fall,* A.R.P.S.

Chemistry of Photography, *J. F. Stirling,* M.Sc., A.I.C.

Child Photography:
(1) **For the Amateur,** *Bernard Alfieri, Jr.*
(2) **Professional,** *Marcus Adams,* F.R.P.S.

Church and Cathedral Photography, *Bernard Alfieri, Jr.,* and *R. S. Illingworth,* M.D., Ch.B., M.R.C.P., M.R.C.S., F.R.P.S.

Cinematography:
Standard, *James Mitchell,* B.Sc., A.I.C.
Of Ilford, Ltd.
Amateur: (1) Apparatus, *H. B. Abbott*
Author of "The Complete 9.5-mm. Cinematographer," "Cine Titling Simplified," "Motion Pictures with the Baby Cine," etc.
Amateur: (2) Beginners, *Harold B. Abbott*
Amateur: (3) Advanced, *Gordon S. Malthouse*
Amateur: (4) Film Processing, *S. W. Bowler,* A.R.P.S.
Amateur: (5) Colour Films, *G. B. Harrison,* Ph.D., F.R.P.S.
Of Ilford, Ltd.

Close-Ups:
(1) **With a Still Camera,** *David Charles,* F.R.P.S.
(2) **In Cine Work,** *G. S. Malthouse*

Cloud Photography, *Bernard Alfieri, Jr.*

Colour Photography:
(1) **General Principles,** *D. A. Spencer,* Ph.D., D.I.C., F.R.P.S.
Author of "Photography To-day" "Colour Photography in Practice"
(2) **Additive Processes:**
Lumière Filmcolor, *Alec. J. Jones*
Dufaycolor, *G. H. Sewell,* A.R.P.S.
Finlay, *G. J. Field*
Chief Technician of Finlay Colour (London), Ltd.
(3) **Subtractive Processes:**
Kodachrome, *T. L. J. Bentley,* D.I.C., A.R.C.S., B.Sc., A.R.P.S., and *E. A. Robins,* F.R.P.S.
Of the Kodak Research Laboratories, Harrow
Agfacolor, *G. L. Harrison*
Vivex, *F. W. Coppin,* A.R.P.S.,
Works Manager of Colour Photographs, Ltd.
Gasparcolor, *Imre Gaspar*
Managing Director of Gasparcolor, Ltd.
(4) **Colour Prints (Paper),** *L. V. Chilton,* M.A., F.Inst.P., F.R.P.S.
Of Ilford, Ltd.
(5) **Pigment Processes: Trichrome Printing (Carbro Process),** *B. Chambers,* F.R.P.S.
Duxochrome, *J. H. Coote*
(6) **Imbibition Processes**
(7) **Toning Processes,** *L. V. Chilton,* M.A., F.Inst.P., F.R.P.S., and *J. H. Coote*
Chromatone, *J. H. Coote*
Photocolor Bi-Chrome
(8) **General Notes for Amateur Workers,** *Bernard Alfieri, Jr.*

Commercial Photography, *David Charles,* F.R.P.S.

Competitions for the Amateur Photographer, *F. J. Mortimer,* Hon. F.R.P.S.

Composition in Photography, *W. L. F. Wastell,* Hon. F.R.P.S.

Contrast in Negatives and Prints, *David Charles,* F.R.P.S.

Copying with Large and Miniature Cameras, *W. R. Ayling,* A.I.P.A., A.R.P.S.

Copyright Law for the Photographer, *W. T. Creswell,* K.C., Hon. A.R.I.B.A., A.S.I.

Cost and Economy in Amateur Photography, *Bernard Alfieri, Jr.*

Costs and Costing in Commercial Photography, *W. G. Briggs,* F.R.P.S.
Of Studio Briggs, Ltd.

Dance and Ballet Photography, *Peggy Delius,* A.R.P.S.

D. & P. Work :
(1) **General,** *H. Norman Blinkhorn,* A.R.P.S.
President Professional Photographers' Association
(2) **Kodak Methods,** *A. W. Richardson,* A.R.P.S.
Of Kodak, Ltd.

Dark-Room :
(1) **Planning and Arrangement,** *Bernard Alfieri, Jr.*
(2) **Fittings and Equipment,** *Bernard Alfieri, Jr.*
(3) **For Professional Workers,** *W. G. Briggs,* F.R.P.S.
(4) **Its Proper Illumination,** *J. C. A. Redhead,* F.R.P.S.
Of Kodak, Ltd.

Depth of Focus and Hyperfocal Distance, *Leo A. Leigh,* B.Sc., A.C.G.I., A.R.P.S.

Desensitizers and Desensitizing Methods, *J. D. Kendall,* Ph.D., A.I.C., D.I.C.
Of Ilford, Ltd.

Developers :
(1) **Chief Classes and Characteristics,** *David Charles,* F.R.P.S.
(2) **Standard Formulae,** *A. L. M. Sowerby*
Of "The Amateur Photographer"

Developing :
(1) **Principal Methods,** *F. J. Mortimer,* Hon. F.R.P.S.
(2) **Dish Method**

Developing *(contd.)*
(3) **Factorial Development,** *David Charles,* F.R.P.S.
(4) **Tank Development (Time and Temperature),** *David Charles,* F.R.P.S.
(5) **A Selection of Modern Tanks**
(6) **Methods for Film Packs,** *W. L. F. Wastell,* Hon. F.R.P.S.
(7) **Methods for Miniature Films,** *R. G. Lewis*
(8) **Fine-Grain Development,** *A. L. M. Sowerby*
(9) **Physical Development,** *Stanley W. Bowler,* A.R.P.S.
(10) **Instantaneous Method,** *F. J. Mortimer,* Hon. F.R.P.S.

Development :
(1) **The Scientific Basis,** *H. Baines,* D.Sc., F.I.C., F.R.P.S.
Vice-President, Royal Photographic Society
(2) **The Theory Applied,** *W. L. F. Wastell,* Hon. F.R.P.S.

Dog Photography, *Thomas Fall*

Dyes Used in Photography, *J. D. Kendall,* Ph.D., B.Sc., A.I.C., D.I.C.

Electricity and the Photographer, *Bernard Alfieri, Jr.*

Emulsions :
(1) **Technical Principles and Processes,** *H. Baines,* D.Sc., F.I.C., F.R.P.S.
(2) **Properties,** *Olaf Bloch,* Hon. LL.D., F.I.C., Hon. F.R.P.S.
Chief Chemist, Ilford, Ltd.

Enlargers and Enlarging :
(1) **Amateur Methods,** *F. J. Mortimer,* Hon. F.R.P.S.
(2) **Commercial,** *W. G. Briggs,* F.R.P.S.
(3) **Daylight Methods,** *Bernard Alfieri, Jr.*
(4) **Picture-Making and Selection,** *Emslie Dean*
(5) **Shading Control,** *G. K. Seager*
(6) **Choice of Apparatus,** *David Charles,* F.R.P.S.
(7) **Selection of Modern Types**
(8) **Home-Made Lantern,** *S. G. Blaxland Stubbs*
General Editor, Waverley Technical Encyclopedias
(9) **Simple Aids**
(10) **Prints from Cine Frames,** *S. W. Bowler,* A.R.P.S.

For Complete List of Contributors see pages 1328 and 1329 in Volume 2

Editorial Foreword

Not even motoring (if one counts by heads) is a more popular hobby in these islands than photography. About 2,500,000 persons drive motor vehicles (calculating from the licence returns), and, it is estimated, something more than 5,000,000 persons, or one in eight of babe, child and adult, use a camera. This estimate is confined to amateur photographers of all grades, from the many thousands of box camera and roll-film camera novices to the serious photographic workers with apparatus costing from perhaps £20 to £100. When we add the thousands of professional photographers—trade, press, studio, etc.—we have a truly astonishing total. Never was photography so popular as a hobby and craft or so important as a technical instrument. Further, both its popularity and its importance increase steadily, for manufacturers tell us that the curve of consumption of amateur and professional material is rising steeply.

Photography a Vital Modern Need

Photography enters into practically every department and section of the 20th-century world, and without it the activities of that world would be so hampered as to be almost crippled. Even if we could ignore the obvious fact that the absence of cinematography would largely change the character of the daily life of twenty millions of people there remain many other facts none the less vital. Our very food, our clothes, our motor-cars and machinery, industrial processes, all science and medicine, the work of airman, soldier and policeman, owe much of their progress to photography and photographic technique, while to contemplate newspapers and periodicals in their once pictureless state is nearly a mental impossibility.

The reasons for this massive advance are not far to seek. One is the really extraordinary improvement in the technical quality of the photographic material now available compared with that of only 10 or 15 years ago, and another is the introduction of new types of camera equipment providing possibilities and a range of work which was hardly conceivable but a decade or so back.

For the first group of advances, both amateur and professional have much to thank the cinematograph. The developments of the screen called urgently for material more and more sensitive, for higher speeds combined with better colour renderings—requirements once almost incompatible—bigger lenses, infra-red sensitive emulsions, and so forth.

Amateur's Debt to the Films

The film industry footed the bill for the research and technical work required, and the amateur of the "still" camera has profited by the results. So we get our super-sensitive panchromatic films of speeds almost fabulously high, that so widen the range of indoor and outdoor photography that the old fault of the amateur "snapshotter"—under-exposure—is already disappearing and is, in fact, being replaced by a tendency to over-exposure.

The new types of camera now available are most largely included in one class, that loosely called the miniature. The extraordinary success of that new class is undeniable. Not only has it the technical qualities of the large-aperture short-focus lens but it also presents the sheer practicability of combining in one piece of apparatus in a mere corner of the pocket all the technical equipment required for an immense variety of work.

A Comprehensive Guide

In photography, as in every other craft which is essentially technical in basis, there is an enormous body of knowledge in existence, and workers of every stage and grade find that guidance through that mass of fact and theory is essential. Up to the present there has been lacking a concise and comprehensive guide to the theory and practice of the art of photography. And it is here that, in the issue of the MODERN ENCYCLOPEDIA OF PHOTOGRAPHY, a modest record is claimed inasmuch as there has not, in recent times, previously been published an alphabetical encyclopedic work attempting to cover the whole field of photography.

The scope of our work is best seen by the groups of subjects—as listed below—upon which the alphabetical scheme is based.

It may be emphasized that in addition to comprehensive treatment of all aspects of amateur photography (with due attention to professional work) special sections appear in every appropriate article on sub-standard cinematography and miniature camera work.

It is to be noted that the present compilation is arranged as a semi-classified alphabetical Encyclopedia complemented and supplemented by a large General Index. That is, it is alphabetical in form, but it groups main subjects under main headings instead of breaking them up into many subsidiary and small headings. Thus, instead of having 40 or more headings for different developers there is one group of headings: DEVELOPERS, DEVELOPING and DEVELOPMENT, which, besides describing the principles and the standard and the newer methods of Developing, gives full working details and formulae for the most generally used developers and gives proportions of mixtures and other details for all other developers in tables.

The purpose of the MODERN ENCYCLOPEDIA OF PHOTOGRAPHY is a triple one. It aims so to interest and enlighten the ambitious novice as to help and guide him to better and better photographs; it provides the serious amateur with the means for progress in all directions in his hobby and craft; and, thirdly, it presents to the professional a body of sound informative matter which will be of value to him not only for reference in his own work but also in his association with his amateur clients.

And if it be objected that some of the matter presented is elementary in character let it be remarked that in photography, as in other crafts, sound practice is not possible without a clear grasp of elementary principles. Editorial experience has too often

Group List of Subjects

PHOTOGRAPHY FOR NOVICE AND AMATEUR
Theory and Practice of "Still" and Cine Photography simply explained for Beginners; Hints and Tips for the Amateur; Competitions; Exhibitions, etc.; Defects and Faults.

PHOTOGRAPHIC PRINCIPLES AND PRACTICE
Instruction for the Serious Amateur and Reference for the Expert; All Modern Processes Explained with Tested Formulae and Working Notes; Composition; Enlarging; Lighting.

OPEN AIR PHOTOGRAPHY
Action Photos; Landscape; Sport: Football, Racing, Athletics, Hunting, etc.; Nature Photography (Animal—Bird, Cat, Dog, Horse, etc.; Plants, Trees and Flowers); Seasonal Photography; Seaside and Seascapes; Marine Photography; Cruising; Holidays.

"MINIATURE" PHOTOGRAPHY
All forms and apparatus, 35-mm. film and other sizes. Special sections throughout the work.

CINEMATOGRAPHY (SUB-STANDARD)
For Beginner and Expert. Apparatus (8 mm., 9·5 and 16 mm.). Methods and Practice—Cutting, Editing, Titling, Scenarios, etc. Processing, Colour, Screens, Trick Work.

CAMERAS, LENSES AND OTHER APPARATUS
Cameras (Still and Cine), Lenses, Shutters, Enlargers, Meters, Projectors, Lanterns, etc. Chief Makes Described in Detail.

GROUP AND PORTRAIT PHOTOGRAPHY
Child; Indoor Photography; Portraiture (Amateur and Professional).

CHEMICALS AND CHEMISTRY
Chemistry of Photography: Developers; Fixers; Intensifiers; Desensitizers and other Agents; Formulae and Tables.

PROCESSES AND MATERIALS
Developing; Fixing; Printing and Special Processes; Films; Plates; Bromide Papers; Intensification; Reducing; Washing.

COLOUR PHOTOGRAPHY
Simple Theory and Working of all Modern Processes—Transparencies, Cine, Papers, Prints, etc. (Agfa, Dufaycolor, Kodachrome, Finlay, Vivex, Technicolor, Trichrome Carbro, Gasparcolor, etc.).

COMMERCIAL AND PRESS PHOTOGRAPHY
Advertising; Commercial; Photo-mechanical Work; General; Freelancing; Competitions; Copyright Law.

SPECIAL BRANCHES
Aerial, Alpine, Astronomical, Infra-Red, Telephotography, Violet Ray, Radiography (X-rays), and other Branches of Scientific and Technical Photography; Polarized Light.

TECHNICAL AND THEORY
Emulsions; Optical Principles (Focal Lengths, Depth of Focus, Hyperfocal Distance, etc., etc.); Dyes; Exposure; Speed and Speed Figures; Density and Tone Values; Filters.

PROFESSIONAL PHOTOGRAPHY
Child Portraiture; D. and P. Work; Enlarging; Dark-Rooms; Photography as a Career; The Studio, Its Planning and Work; Repairs.

MISCELLANEOUS
Trick Photograpny; Photomontage; Photo-Mural; Albums; Copying; History of Photography; Night Photography; Stage Photography; Stereoscopic Photography; Photostats; Zoo and Aquarium Photography.

SPECIAL PROCESSES
Carbon; Carbro; Bromoil; Collotype; Gum Bichromate; Platinotype, etc.

shown that it is not only the schoolboy photographer who needs instruction. Even travellers and scientists have, in the very recent past, returned from expeditions where opportunities for photographs of very real importance have been lost for lack of simple photographic knowledge.

In this triple purpose our ENCYCLOPEDIA is fortunate in having the close co-operation in both text and illustration of leading journals in the amateur photographic world. Mr. F. J. Mortimer, long a leading figure in photography and Editor of *The Amateur Photographer* (Iliffe & Sons, Ltd.), acts in the dual capacity of Associate Editor and contributor. For both the amateur cinematographer and the miniature camera enthusiast, Mr. Gordon S. Malthouse, Editor of *Amateur Cine World* and of *Miniature Camera World*, also acts in similar capacities. S. G. B. S

EDITORIAL & CONTRIBUTING STAFF

Associate Editors

S. G. BLAXLAND STUBBS
General Editor, Waverley Technical Encyclopedias

F. J. MORTIMER, Hon. F.R.P.S.
Editor of 'The Amateur Photographer' and 'Photograms of the Year'

GORDON S. MALTHOUSE
Editor of 'Amateur Cine World,' and 'Miniature Camera World'

Principal Contributors

Harold B. Abbott
Author of "The Complete 9.5-mm. Cinematographer"

Marcus Adams, F.R.P.S.
Past President of the Professional Photographers Association

Bernard Alfieri, Jr.
Photographic Journalist

E. Searle Austin
Editor of "Advertising Monthly"

W. R. Ayling, A.I.P.A., A.R.P.S.

H. Baines, D.Sc.(Lond.), F.I.C.
Of Ilford, Ltd., Chief Chemist, Selo Works; Vice-President, Royal Photographic Society

Arthur Barrett, F.R.P.S.
Of Kodak, Ltd. Author of "Thirty Years of Press Photography"

U. V. d. Bogaerde
Art Editor of "The Times"

Stanley W. Bowler, A.R.P.S.
Specialist on miniature camera and amateur cine work

W. G. Briggs, F.R.P.S.
Of Studio Briggs, Ltd.

H. A. Carter, F.R.P.S.
Author of "Telephotography"

B. Chambers, F.R.P.S.
Of The Autotype Company, Ltd.

David Charles, F.R.P.S.
Author of "Commercial Photography" and "Brighter Photography"

L. V. Chilton, F.Inst.P., F.R.P.S.
Of Ilford, Ltd.

W. T. Creswell, K.C.
Authority on Copyright Law

E. R. Davies, B.Sc., F.Inst.P., F.R.P.S.
Director of Research, Kodak Research Laboratories

Peggy Delius

J. Dixon-Scott, F.R.P.S., F.R.G.S.
Press and Landscape Photographer; Author of "England Under Trust"

Thomas Fall
Well-known Expert in Animal Photography

G. J. Field
Of Finlay Colour (London) Ltd.

G. B. Harrison, B.Sc., Ph.D.
Of Selo Research Laboratory

G. L. Harrison

G. L. Hawkins, M.C., F.R.P.S.
Member of the London Salon of Photography

J. D. Kendall, D.Sc., A.I.C., D.I.C.
Of Ilford, Ltd., Head of Dye Research Laboratory

Roy King, A.R.P.S.

Leo A. Leigh, B.Sc., A.R.P.S.

R. G. Lewis
Miniature camera specialist

Donald McLeish
Specialist in Alpine Photography

Gordon S. Malthouse
Editor of "Amateur Cine World" and "Miniature Camera World"

James Mitchell, B.Sc., A.I.C.
Of Ilford, Ltd.

F. J. Mortimer, Hon. F.R.P.S.
Editor of "The Amateur Photographer" and "Photograms of the Year"; Author of "Marine and Surf Photography," "Photography for the Press"

Oliver G. Pike, F.Z.S., F.R.P.S.
Author of "Birdland" Nature Books, "Nature Photography"

S. O. Rawling, D.Sc., F.I.C., F.R.P.S.
Author of "Infra-Red Photography"

Paul B. Redmayne, A.R.P.S.

W. B. Redmayne
Specialist in Nature Photography

J. E. Saunders, F.Z.S.
Assistant Editor of the "Photographic Journal"

George H. Sewell, A.R.P.S.
Of Dufay-Chromex, Ltd. Author of "Commercial Cinematography"

P. C. Smethurst, A.R.P.S.
Author of "Exposing Cine Film"

D. A. Spencer, Ph.D., D.I.C., F.R.P.S.
Author of "Photography Today"; Technical Director, Colour Photographs (B. & F.), Ltd.; President R.P.S.

J. F. Stirling, M.Sc., A.I.C.
Technical Photographer

Arthur R. Thompson, F.L.S.
Author of "Nature By Night"

Ian M. Thomson, F.R.P.S.
Author of "Birds From the Hide"

F. J. Tritton, B.Sc., A.I.C., F.R.P.S.
Process Dept., Ilford, Ltd.

Lancelot Vining, A.R.P.S.

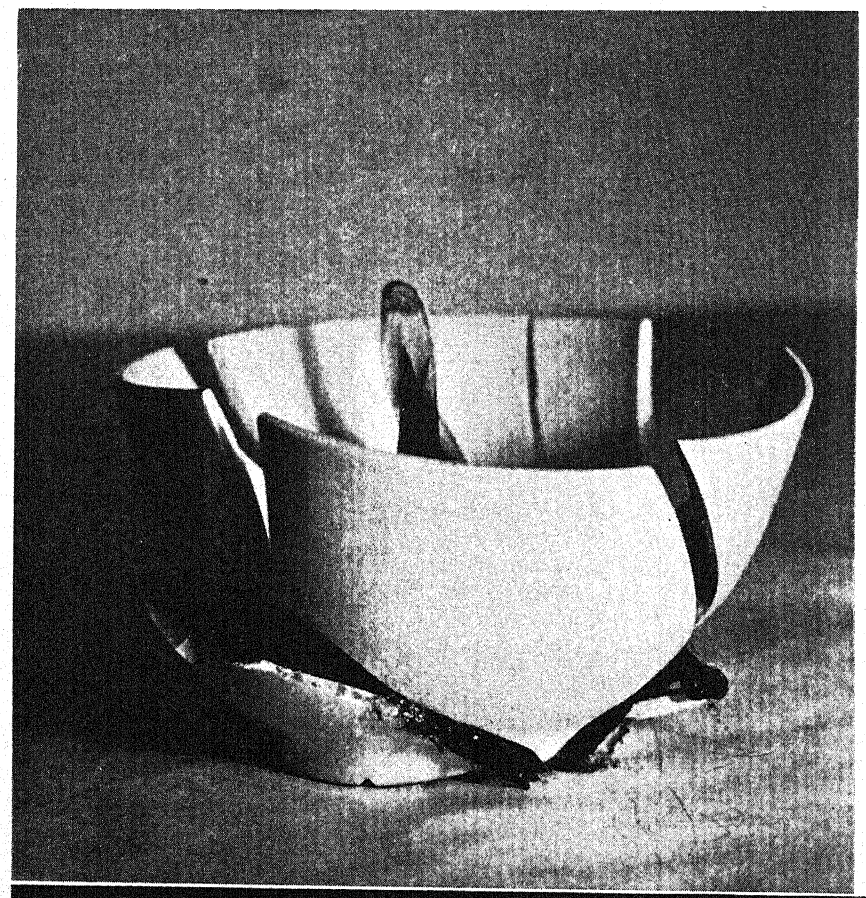
W. L. F. Wastell, Hon. F.R.P.S.
Past President R.P.S.

H. H. Waters, F.R.A.S.
Author of "Astronomical Photography for Amateurs"

F. L. Wills, F.R.P.S., F.R.S.A.
Aerial Photographer (of Aerofilms, Ltd.)

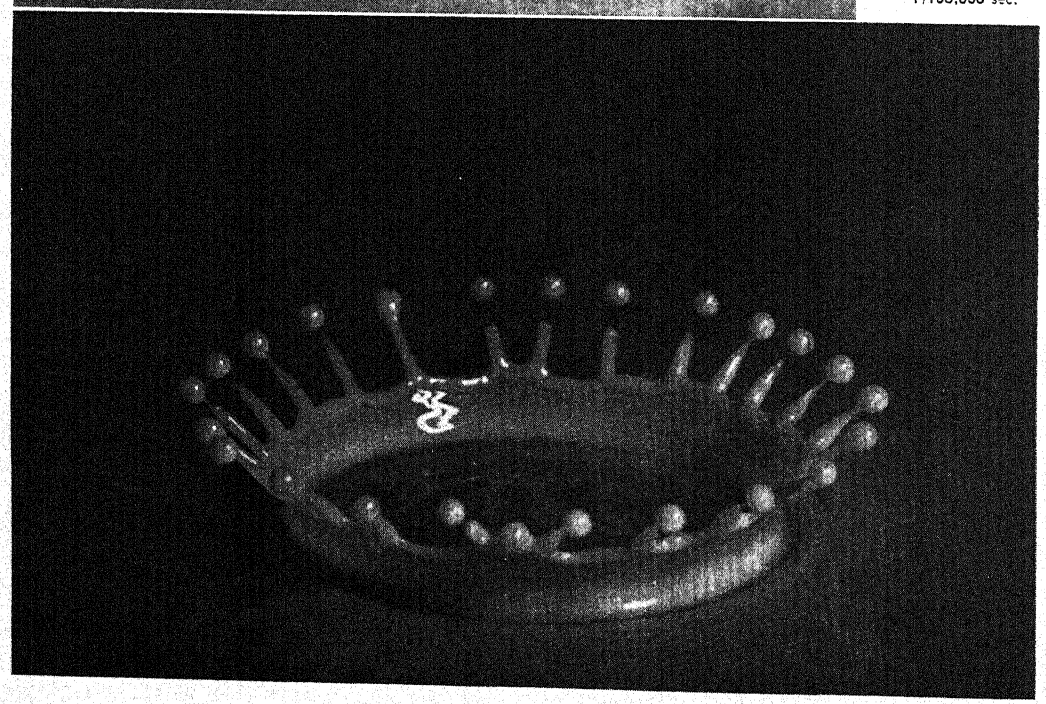
Charles Wormald, F.R.P.S.
Advertising Photographer

For Complete List of Contributors see Last Volume



HIGH-SPEED WORK. The picture on the left of a cup of coffee striking the floor was secured by the electric spark method of photography. The cup was dropped six feet

Exposure 1/75,000 sec., at f16



A DROP OF MILK. Another example of high-speed photography. The "coronet" seen below is the second of a sequence of photographs showing a drop of milk splashing upon impact with a liquid surface

Photos, H. E. Edgerton, K. S. Germeshauser and H. E. Grier. Exposure 1/100,000 sec.

TRIUMPHS OF MODERN PHOTOGRAPHY

F. J. Mortimer, *Hon. F.R.P.S.*

Editor of "The Amateur Photographer" and "Photograms of the Year."
Author of "Photography of the Sea," "Photography for the Press," etc.

A century of persistent endeavour lies behind the perfected photographic processes that exist today. The amazing progress that has been made continues, and in this article there is told the absorbing story of modern photography in all its varied aspects

It is just a hundred years ago that the first results in photography were obtained, although they were very different from what we know as photography today. The experimental efforts of Daguerre, Niepce and Fox Talbot laid the foundations of a wonderful process that has grown from strength to strength in the course of a century, and its triumphant progress now renders it difficult to enumerate all the matters of everyday life in which it plays a part.

There is, however, one essential still common to the production of, say, the high-speed press photographer of today and the groping efforts of the early experimenters. It is light; and upon the action of light the whole structure of photography depends. "Drawing by light" was the not inappropriate description given by the early photographers to their endeavours. Next to light the necessary element is silver. Various salts of this metal in different combinations and media provide the base upon which light can act and produce the photographic image.

Cameras for the Million

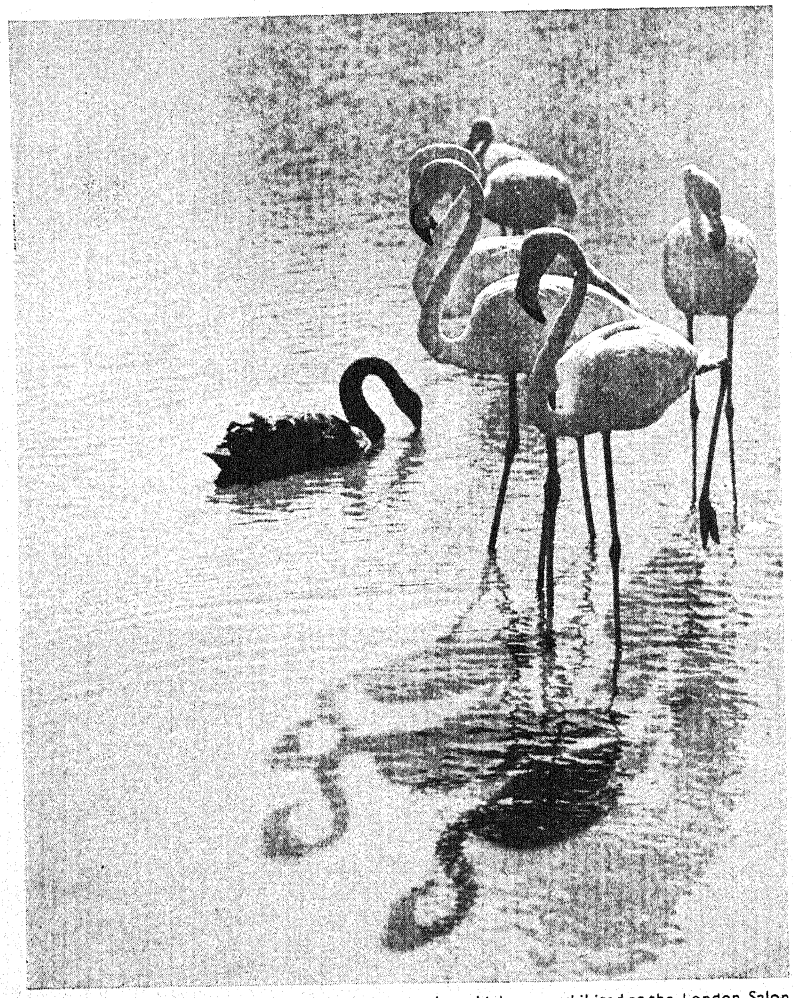
The gradual development of the process to the state of perfection now attained is a remarkable story of experiment, trial and error, research, inspiration and hard work. But it is not the purpose of this article to comment on the historical side of photography so much as to emphasize its present position.

Apart from the different phases of photography in its service to mankind, it is as a hobby for the amateur that it probably claims the interest of the greatest number of camera users. As a hobby it has grown to an enormous extent in recent years, and it has been estimated that there are at least five million amateur camera users in this country alone. A great impetus was given by the introduction of sensitive film on a flexible celluloid base, and the perfection of modern roll-films and the multiplicity of simple cameras for their use have been responsible for much of the widespread popularity of amateur photography. Nowadays the camera has become the regular and constant companion of the holiday-maker and traveller, and is the recorder of every personal incident and accident. This kind of photography has become non-seasonal, and the serious amateur with picture-making aspirations uses the camera all the year round.

A Mighty Industry

As an indication of the amazing growth of photography it has been stated by Dr. K. Mees that the raw materials required annually in the manufacture of the world's photographic materials amount to more than 500 tons of pure silver, 6,000 tons of cotton for film base, 3,000 tons of specially prepared gelatine, and over 12,000 tons of wood pulp for the production of paper. Over half a million miles of film a year are consumed in the making of motion pictures. 1,500 tons of film are consumed by amateur photographers to make their snapshots, and another 7,000 tons of paper to print them on, while 8,000 tons of film, 8,000 tons of glass plates, and 9,000 tons of paper to make portraits and advertising pictures are consumed.

Speed and still more speed is the tendency today, and to secure high-speed photographs all the energies of the modern film- and plate-makers have been devoted to making their materials more perfect, not only as a base for negatives of fine quality, but of ever-increasing rapidity. Not so long ago a plate that was listed at H. & D. 500 was regarded as the last word for instantaneous exposures, and films of that speed were unobtainable. We now have both plates and films with speeds of 7,000 or 8,000, and still the limit does not appear to have been reached. It is obvious to what a great extent rapid



"THE GATE CRASHER." This charming study, which was exhibited at the London Salon of Photography, is strongly reminiscent of Japanese art in its simple grace of design and elimination of non-essentials. The large expanse of foreground, relieved from too much monotony by the shadows in the rippling water, conveys a remarkable feeling of quietness and repose

Photo. Kenneth M. Trathen. *(Copyright Kodak, Ltd.)*

As the demands of the amateur photographer have grown, so the camera manufacturer has kept pace with him. The camera made for the amateur today is a beautiful piece of mechanism; in its finer developments it is a precision instrument. This particularly applies to many of the modern miniature cameras, which have been produced with the meticulous care and perfection of apparatus that characterizes a high-class watch. The optician has also kept pace with the emulsion maker, and photographic lenses of large apertures and wonderful defining powers are available for every type of camera.

This perfection of apparatus and materials for use by every kind of photographer, particularly the amateur, has had the effect of stimulating the pictorial instinct of workers who use them. The ease with which ordinary photographs can be taken today has not only attracted more people to photography as a hobby, but by simplifying the manipulations connected with the apparatus the user has greater opportunities of devoting his attention to the subjects he wishes to portray. In this manner picture-making with the camera has extended in every quarter; more people are taking good photographs, and a greater appreciation of the beauties of nature has grown in the modern generation—inculcated by the influence of photography.

While this is the day of the small camera and of film photography larger cameras, from quarter-plate size upwards, are still

exposures in difficult situations and poor light are now possible. It says much for the chemist and emulsion maker that these remarkable speeds in modern negative materials have been secured without loss of essential photographic characteristics.

On the contrary, new and better qualities have been introduced, particularly in the direction of panchromatic and fine grain emulsions. A very large proportion of the films and plates made today are fully panchromatic (*i.e.* sensitive to all colours of the spectrum), while orthochromatic films and plates have taken the place of the non-colour-sensitive type of ordinary plates and films which were used a few years ago.

in use in many fields particularly among pictorial workers, who stick to their larger size reflex cameras, and also by the professional photographer, who finds it difficult to attune himself to the miniature after a lifetime of practice with a studio camera. Press photographers in many cases are still wedded to special cameras and plates, but even here the miniature and films are gradually making their presence felt.

Two notable points have arisen in connexion with the modern vogue of the miniature camera. One is the necessity for the production of negatives of extremely fine grain (a matter that the emulsion makers and manufacturers of chemicals for development have attended to), for the tiny negatives must inevitably be enlarged considerably before being acceptable as pictures; and, secondly, the small camera has for the same reason brought in its trail new developments in enlarging apparatus.



RADIOGRAPHY IN HORTICULTURE. Besides its vitally important aid in surgery, X-ray photography has many other uses. Here is a radiograph of part of a horse chestnut tree. All the delicate formation of the veins of the leaves is clearly revealed, and the structure of the stems is shown with wonderful clearness

Photo, Herbert Flower, F.R.P.S. (Ilford, Ltd.)



PHOTOGRAPHIC PSEUDO-RELIEF. This "bas-relief" photograph was produced by making a transparency from the negative by contact. The two were then placed together but slightly out of register, and the resulting print has a relief effect

Photo, David Charles

It would probably be found, however, if a census could be made of the cameras used in Great Britain alone, that the most popular size is $2\frac{1}{4} \times 3\frac{1}{4}$ in. This conclusion is arrived at from statistics that have been given by the makers of films, this size of roll-film having more than double the sale of all other sizes.

The illustrated press today depends almost entirely on photography and photographic methods for the presentation of pictures to

its readers. Not only are the entirety of news pictures secured in the first place by means of the camera, but these and all other illustrations are dependent on photographic processes, by which they are converted into the printing blocks that enable the pictures to appear on the printed page. Without photography, illustrated journalism would cease to exist, but with it every event that is happening everywhere is recorded in pictures and brought easily to the eyes and understanding of every reader within a minimum of time.

Press photography is a phase of the work which has steadily improved with the increasing perfection of sensitive materials, instantaneous shutters and high-speed lenses.

The Ubiquitous Press Camera

The modern press photographer can tackle practically any subject with every chance of success. In addition to everyday subjects in daylight, which are given the publicity of the press, snapshots in the theatre with ordinary stage lighting, street scenes at night, and "candid portraits" at dinner parties, are all within his range, and when the light is inadequate he can supply his own with flash-bulbs.

These subjects, it may be said, are also capable of being dealt with by any properly equipped amateur photographer, but the press photographer generally works against time, and his pictures have to be in print in a matter of a few hours or less.

A further development of the press photographer's activities is the making of news reels of topical events for the cinemas. It is probably not fully realized by the millions of people who are daily entertained, amused or instructed by the cinema that "the pictures," which have become such a commonplace of their everyday life, are also dependent entirely on photography.

Cinematography, which has grown step by step until it has reached the state in which we know it today, is photography, used in a particular fashion, with the aid of a special form of camera and projecting machine. Yet it is accepted without question or thought by the millions who regard "the movies" in much the same way as they accept their daily paper. Without photography the cinemas of the world and an enormous industry (in America it ranks fourth among the major industries) would disappear.

In addition to its entertainment value there is a remarkable phase of cinematography that has peculiar advantages in many directions. It is that known as "slow motion." This enables rapid action to be shown on the screen, but slowed down so considerably that each individual movement can be analysed in detail—movement that in many cases is too rapid for the eye to follow in actual life. For this work the successive exposures of the cine camera are taken at a much faster rate than usual, and the film is projected at the normal speed.

Slow and Fast Motion Marvels

Applications of this method in the realms of sport have been very successful in enabling the actions associated with boxing, tennis, rowing, racing, golfing and other athletic sports to be examined in a leisurely way. A movement that occupies a second or two can thus be prolonged to a minute or more. Effects in style can be studied and, if necessary, corrected. In some cases, points of dispute in races have been settled by slow-motion cinematography.

The reverse of this, in which cinematography has been able to effect an apparent miracle, with a high instructional flavour, has been the depicting of very slow-moving objects at a greatly increased speed. Here, by exposing the film at regular long intervals and then projecting it at normal speed, movement that may occupy days or weeks, such as the evolution and growth of a flower from bud to full bloom, can be presented in action to the eye in a matter of minutes.

Cine Camera in Our Daily Life

In education, medicine and commerce the cine camera and projector play an important part, and in sub-standard form provides a further hobby for hundreds of thousands of enthusiastic amateurs.

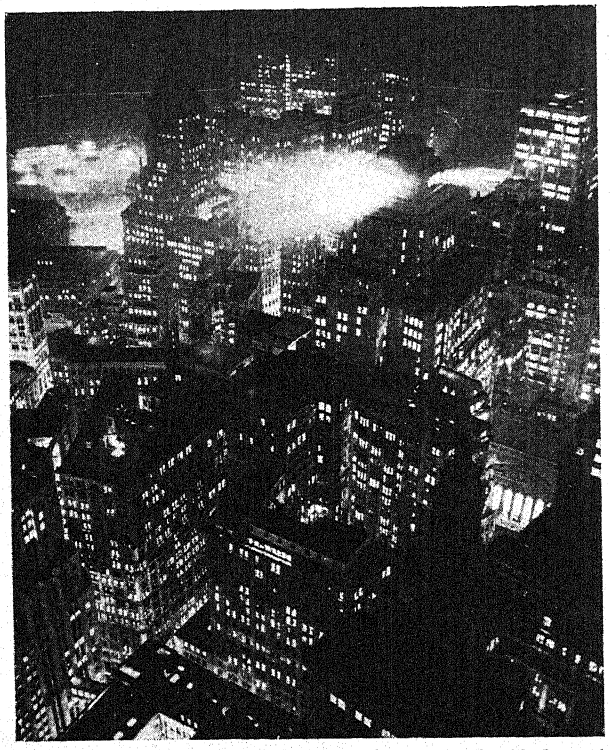
The introduction of sound in cinematography for presentation has been another landmark, and the talking picture, a remarkable achievement, is accepted without question. This development is dependent on the conversion of sound energy to light energy which is recorded photographically on a narrow "sound-track" on the band of cine





AGE AND BEAUTY. Here is a striking example of what can be done in the way of portraiture with the miniature camera. In spite of the high degree of enlargement, detail, texture and modelling are fully apparent. Actual size of the contact print is shown below, left

Photo, L. Pritchard. Compass camera, exposure 1/25 sec., f3.5, on Ilford hypersensitive panchromatic plate, Wratten X1 filter



CITY LIGHTS AND MODERN EMULSION. New York's financial centre photographed by night from the top of the Cities Service Building. Upper left is seen the tower of the Rockefeller Building, while the Corinthian portico ablaze with light on the lower right is the entrance to the New York Stock Exchange. Note the complete absence of halation, even from the searchlight on the tower, and the perfection of tones and detail

International News Photos

film itself for re-conversion again into sound as the picture is being projected.

Colour, too, is assuming a more definite place in the cinema, and in the course of time will probably replace the black and white pictures.

While colour photography may be said to have had a beginning with the work of Clerk-Maxwell in 1861, it is still in a transitional stage, and colour photography on paper, which is the popular ideal of colour photography, is on the point of a definite achievement. Considerable progress has been made in the production of transparencies in colour direct in the camera, and a variety of methods have been invented and perfected for this purpose. Those most in use at the present time for camera work are Dufaycolor, Agfacolor, Lumicolor, and the Finlay process. Some of these, with the addition of Kodachrome, Technicolor, Gasparcolor, and a number of others not so widely used, are available for colour cinematography.

Another modern application of photography, which is becoming universally accepted, occurs in the advertising world. While many firms still prefer to utilize the skill of the draughtsman artist to provide illustrated advertisements, the product of the camera is steadily asserting itself, as may be seen in an article discussing the subject at length by Mr. Searle Austin in a later page.

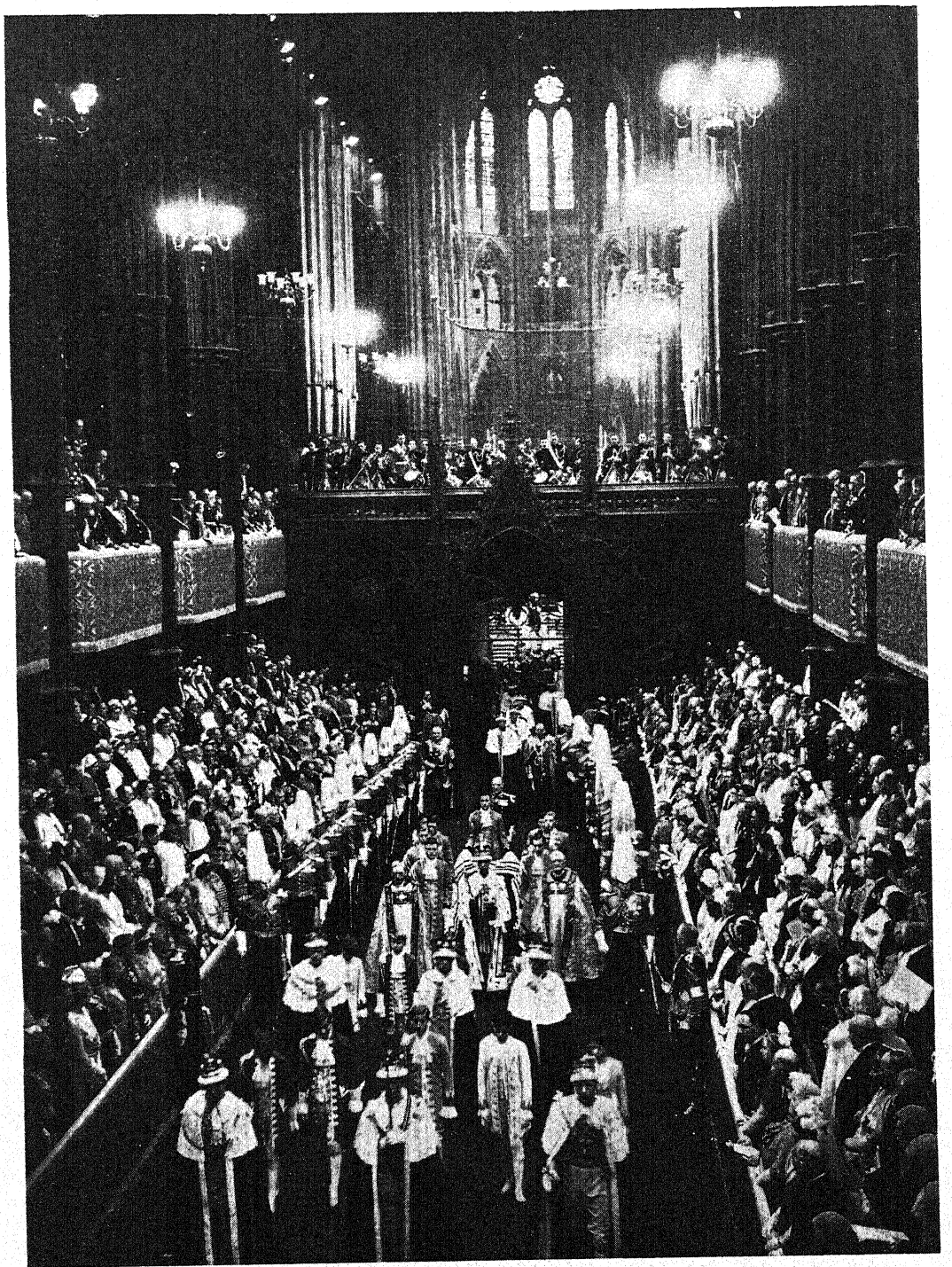
In practically every phase of industry photography enters today. To enumerate the variety of its applications in the daily life of the people would occupy more space than is available here, but among many others we find that it plays a part in the production of the clothes we wear, the furniture we use, and the food we eat. It is employed in testing the water we drink, and even the air we breathe.

To take two examples of everyday familiar matters: the British Boot, Shoe and Allied Trades Research Association employ photography and X-ray work extensively in the production of more comfortably fitting shoes. The modern mass-produced shoe owes much of its perfection to the photographic records that are being made regularly of feet in various positions.

In the manufacture of artificial silk photo-micrography plays a very important part. The research departments of this great modern industry learn from photo-micrographs how far the cellulose threads approximate to the natural product of the silkworm, and repeated experiments enable the process to be brought up to, and kept at, a high state of perfection.

Photography and Mass Production

In the linoleum trade photography in the production and application of patterns has helped to cheapen the manufacture, and a notable development of the same idea arises in the furniture and wood trade, where finely figured woods have been perfectly imitated by printing enlarged photographic images of the grain of expensive woods on to a cheap plywood base. The results are remarkable and permanent, and the cost is small. Photography has also been called in



SUCH A PHOTOGRAPH COULD NOT HAVE BEEN TAKEN FIVE YEARS EARLIER. This remarkable press photograph of the newly crowned King George VI leaving the Coronation Theatre in Westminster Abbey after the ceremony, was taken from a canvas "hide" built over the West door, the lens of the camera protruding through a hole cut in the canvas. A specially speeded-up Ilford hypersensitive 9 x 12 cm. plate was employed. Modern wide-aperture lenses and the rapidity of present-day emulsions enabled the photographer to secure this historic photograph despite comparatively poor lighting conditions

Fox Photos; exposure 1/10 sec., f 3.5

for wall decoration, and photo murals on a large scale have been the feature of many recent exhibitions.

Even in the kitchen photography finds its uses. To take one at random: enlarged X-ray photographs, taken during the process of cake-making, have shown that different qualities of baking-powder produce different-sized bubbles of gas in the dough. When these become too big, air passes and the cake becomes dry. Other varieties of baking-powder, giving smaller bubbles more evenly distributed, keep a cake moist. The photographic data secured by these means are made use of by big catering concerns.

In agriculture the effects of fertilizers on the crops, vegetables and trees have also, when recorded photographically, afforded much valuable information for future treatment on various types of land. In building operations and with mass-produced machinery photography also plays an important part, while in the engineering industry photography is in constant demand, and is being used more and more to replace elaborate and costly plans for obtaining accurate records of machinery construction and for comparisons of design, etc.

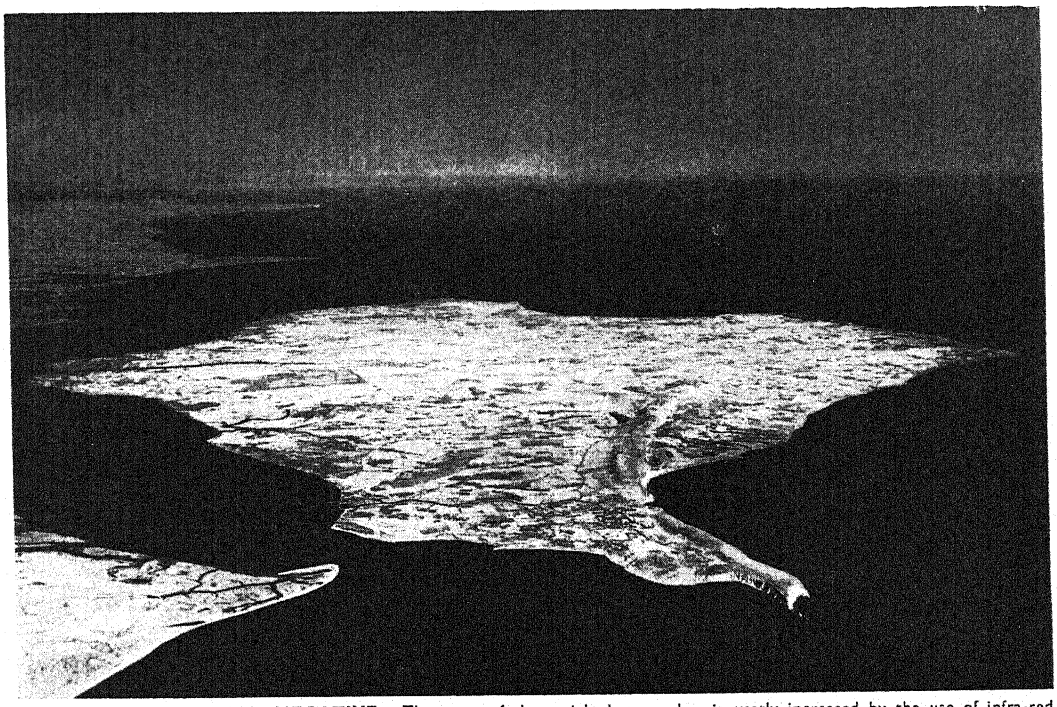
The camera, microscope and X-rays combined have become almost indispensable in their service to metallurgy. Here, modern progress in the construction of steel girders, the metal parts of aeroplanes and engines, owes much to photography and X-ray. Minute inspection of the properties of the material and the disclosing of hidden flaws by these means have become routine work in the industries associated with metal manufacture, and the knowledge obtained enables more perfect products to be secured for the purposes for which they are intended. The big railway companies now record by photography everything concerning their rolling stock, from the first detail of construction to the finished locomotive. Records of all data of manufacture for reference and comparison and photographic tests of the materials employed ensure better production, allied with safety.

In modern medical practice photography



TRIUMPH OF THE PAST. Unparalleled as are the photographic achievements of this modern world, there were nevertheless outstanding triumphs in the very early days of photography. Here is a wonderful example of the work of David Octavius Hill, a photograph of Newhaven fishwives taken more than 90 years ago

Lent by J. Craig Annan. Hon. F.R.P.S.



ISLE OF WIGHT ON ONE NEGATIVE. The scope of the aerial photographer is vastly increased by the use of infra-red material. This photograph was taken at a height of 18,000 feet, and clearly shows the whole of Isle of Wight and its many miles of coastline. With infra-red screens, haze, which blocks vision, is readily penetrated

Photo, "The Times"

plays a very important part (apart from the well-recognized functions of X-ray work) when permanent records have to be made and duplicated for many purposes.

Ordinary camera photography, both in monochrome and colour, is now very definitely established in hospital routine for recording details of interesting cases, surgical operations and special treatments, the photographs providing a most accurate pictorial sequence of their progress. Here, also, photo-micrography proves its value in dealing with the vital work of bacteriological research. These



FIFTY MILES OF VIEW Taken from the side of Ben Vrackie, Perthshire, this infra-red photograph (Ilford plate and screen) shows a panorama extending for 50 miles, with the Glencoe mountains in the distance. Note the contrast without extremes of "soot and whitewash"

Photo, D. W. Bradford





WHAT A MINIATURE CAN DO. In this photograph at an escalator top there is a spontaneity which, combined with the composition and silhouettes, makes it a most arresting picture. Nothing could compete with the miniature camera on an occasion like this

Photo Leo A. Leigh, A.R.P.S.; Leica, 1/20 sec., f1.9 ; Agfa ISS; Hektor 7.3-cm. lens

photographs have not only their value as records of particular cases, but their subsequent applications for the benefit of students in medicine and illustrations in medical works have untold value.

In aerial photography great strides have been made in a very short time, and there is no doubt that the greatest incentive for progress in this work, as in flying itself, was brought about by the necessities of the Great War. During the period of the War, as is well known, photography from the air became a very definite factor in reconnaissance. Now that photographic surveying from the air is a very important phase of modern endeavour, the world is being re-mapped, and aerial photography bids fair to replace entirely the methods for map-making that have been in use for generations. This phase has many additional applications, as, for instance, in its use by railway companies in ascertaining the development of various districts served by their lines, and to act as a guide for future developments. Aerial views of town expansion show this at a glance and tell the story far better than figures and other data. A section by Mr. F. L. Wills in pages 50 to 58 elaborates and illustrates this theme.

In dealing with congested traffic problems aerial photographs have afforded outstanding assistance to the Commissioner of Police, and dock authorities have also found aerial photographs of great value when dealing with extensions. Brewery companies have employed such photographs to bring to the notice of licensing authorities the growth of particular districts, as an argument in favour of new applications for serving those districts.



MINIATURE REFLEX WORK. This pleasing child study forms a good example of a photograph that is enhanced by attention to rhythm and balance. Its success may be attributed largely to the virtues of the miniature type reflex camera

Rolle'cord (Triotar lens). f11, 1/25 sec.

The archaeologist in particular makes use of aerial photography in tracing the course of ancient earthworks, etc., which are perceptible only when seen from a height, and, in many educational establishments low-angle and oblique aerial photographs are frequently utilized in place of models for instructional purposes; while, in teaching geography, the student's imagination is stimulated by these pictures in a way that no ordinary maps could achieve.

Extending the Camera's Range

The utilization of infra-red light rays has also proved very effective in aerial photography and, by the use of special infra-red filters and plates, extinction of mist and haze has extended the range of the camera. Although well known years ago, these rays have many modern applications, some of which have been utilized in pictorial photography. More frequently, however, they are employed in record work, notably in dealing with the photography of writing on valuable papers that have been burnt or become charred in a fire, in the detection of forgeries, in the deciphering of old manuscripts, and in the comparisons of the constituents of various materials in the textile and food trade. Infra-red photography has also found an application in the diagnosis of certain diseases. The rays have the property of penetrating the skin and recording the layers beneath; changes invisible to the eye are thus capable of being recorded by the camera.

In recording high-speed movements that are beyond the capacity of the human eye to observe, photography has also proved its power as an aid to scientific investigation. Photographs of bullets in flight, for instance, have been taken with the aid of the light given by an electric spark of a duration of 1/1,000,000 second.

The Camera and the Criminal

In the detection of crime and in the settlement of legal disputes more and more use is being made of the peculiarly accurate qualities of photography. The modern detective is well acquainted with its innumerable applications and, from the detection of forgeries or bloodstains to the broadcasting of criminals' portraits or the photography of finger-marks at the scene of a burglary or a murder, it is in constant use by the detectors of crime. Staff photographers are now regularly employed in the police force and, in many cases, have special departments of their own. This particularly applies to the photographic department of New Scotland Yard, where finger-prints of criminals in all parts of the country are recorded, photographed, enlarged, and kept for reference and comparison. With the microscope and the spectroscope the camera plays a big part in the detection of crime, and photographs are regularly accepted as evidence.

An enormous amount of remarkable and valuable work has been accomplished, and is still being done, with the camera and cine camera in the realms of natural history. Photography has penetrated the innermost secrets of nature, and the modern nature student relies on the camera for results far in advance of anything that any graphic method of the past could produce. It is not only in the portrayal of the habits and lives of birds, beasts, fishes, insects and reptiles, and in the vegetable kingdom also, that the camera gives such a clear and convincing story, but, in conjunction with the microscope, the realm of minute living nature is disclosed, and an amazing world, invisible to the eye, is brought to our knowledge. This, indeed, is one of the great triumphs of the camera, particularly when the pictures are presented through the cinematograph.

Photographic Records and Surveys

The making of records has always been one of the outstanding qualifications of photography, and it is probably unequalled in comparison with other methods of recording. Records made by the camera, when properly done, are accurate and, without doubt, represent the thing itself. The copying of books, manuscripts, plans, etc., has become a regular business, and, where much of this work is undertaken, semi-automatic cameras are used which produce the results in a minimum of time. Of these the Photostat machine, in which the photographs are made directly on to sensitized material, which can be developed at once, is probably the best, and is largely used in commercial and government establishments. Another machine is the Recordak, a remarkable modern invention, in which documents of all kinds are photographed on a continuous

cinematograph film 35 mm. wide. It was originally invented for the photography of series of bank cheques of which photographic records were desired. The application of this form of copying has been applied to libraries, so that newspapers or every page of a book can be rapidly photographed on tiny negatives, which are then capable of being enlarged perfectly to the original size, or examined in a viewing machine with suitable magnifiers in the negative form. The value of this method, apart from the great saving of time, lies in the saving of storage space required when compared with photographic copies as made previously on large plates. The contents of a complete library can now, if necessary, be photographed in this way, and the storage space of the negatives is almost negligible.

The recording value of photography has also for many years been applied by record and survey societies in all parts of the country. These have been responsible for taking a collection of photographs of ancient buildings and evidences of old customs, etc., the prints being stored in museums. Historical subjects and events thus recorded and preserved will be of untold value to historians and future generations.

In astronomy, photography plays a part the importance of which it would be hard to over-estimate. The cumulative effect of light on the photographic plate has been turned to account in making surveys of the heavens, and stars invisible to the human eye have, with prolonged exposures, recorded themselves adequately on a photographic negative. The making of star maps has become very definite work, undertaken by astronomers in the great observatories of the world, and, in conjunction with the spectroscope, astronomical photography is adding yearly to human knowledge some solutions of the vast problems of other worlds.

In this age of rapid evolution, mechanical invention and speed, when new ideas appear and are developed fully in the minimum of time, photography stands out as a wonderful example of a process approximating to the miraculous, not only in itself, but in its innumerable applications. Not inaptly in the past was this daughter of chemistry and optics called "the Cinderella of the Arts," but today she has become the Princess, and in her palace of light all the world pays tribute.

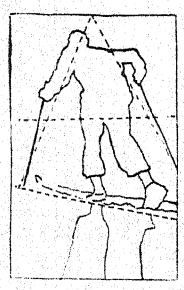
With the realisation of the part that photography is playing in its triumphant progress through the ramifications of modern life, one may well wonder what its future activities will be. There appears to be no limit to its creative accomplishments in every direction, and the mechanisation of many of its performances today suggests a still greater perfection of results in the future.

What has been done in the past by photography is only an indication of what it is capable of doing in the future, and the art of the camera during the next 50 years may well show developments that will be as great as those during the past half-century. It is a protean process of infinite possibilities and without limitations.

All the applications of modern photography referred to above and many others are recounted in some detail in the appropriate pages of this ENCYCLOPEDIA.

Notes on Composition of "THE SKIER"

A pyramidal composition tends to be static, but in this picture there are other strong factors which all combine to convey a distinct suggestion of forward motion. There is the inclination of the whole body and the bent head, and there is also the fact that the triangle which encloses the figure is not completely included in the picture space.

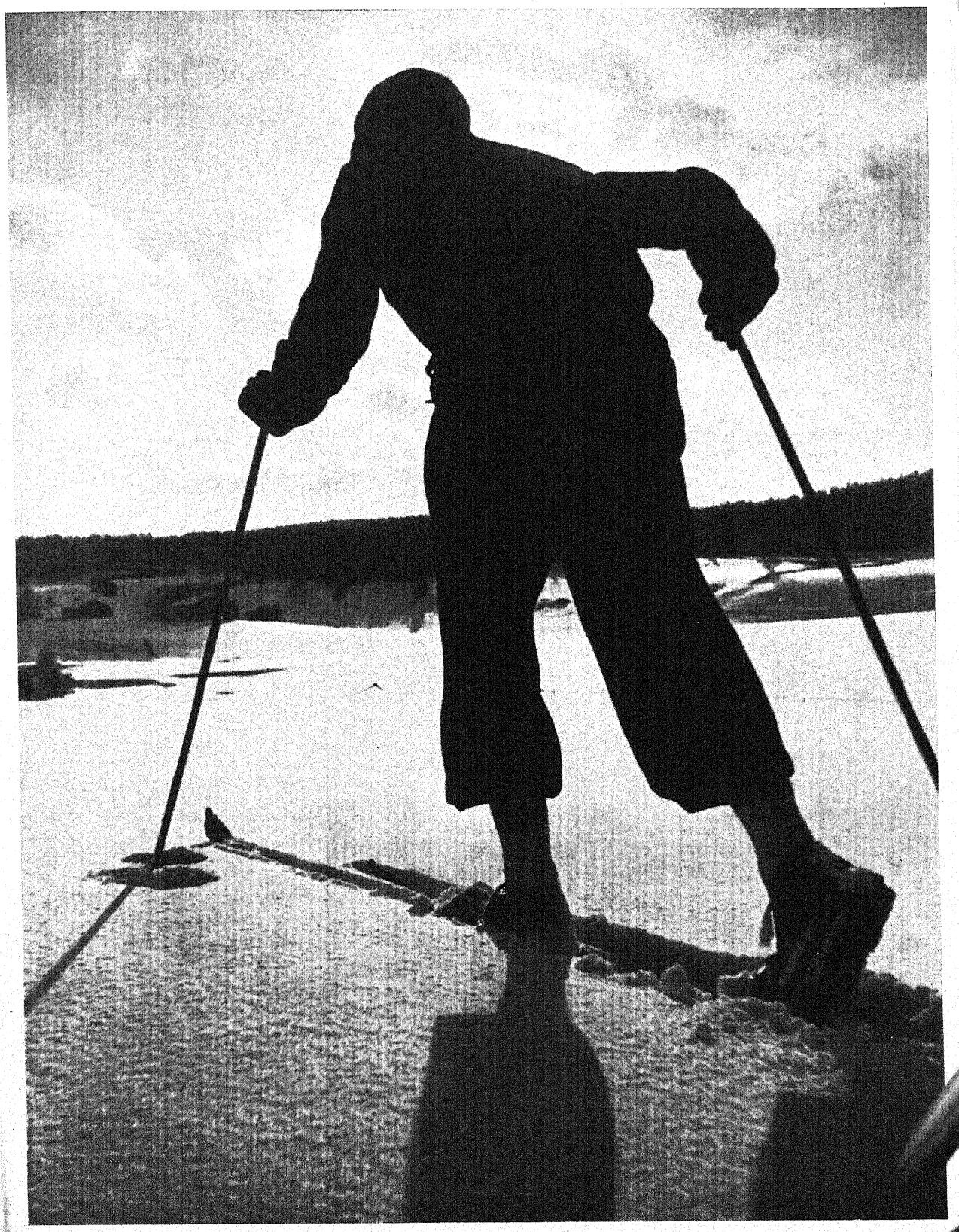


The right-hand corner has not yet moved into the frame. Then the base of the triangle and the skyline are converging in the direction of movement. The vigorous silhouette of the figure is impressive. Seen against the light as it is there is no need for detail and texture in the clothing, but reflected light from the snow gives effective form and gradation to the feet. Texture in the surface of the snow is finely emphasized by the glancing light, and the cast shadows form useful connecting links with the frame; while the shadowed ski tracks give a sufficiently firm base for the figure.



In contrast with the smooth surface of the snow, the sky is pleasantly varied and properly luminous, while the strip of landscape is rightly subordinated, and its horizontal form gives variety in contrast with the vertical mass of the figure. Altogether it forms a fine action picture, and it is good both technically and pictorially

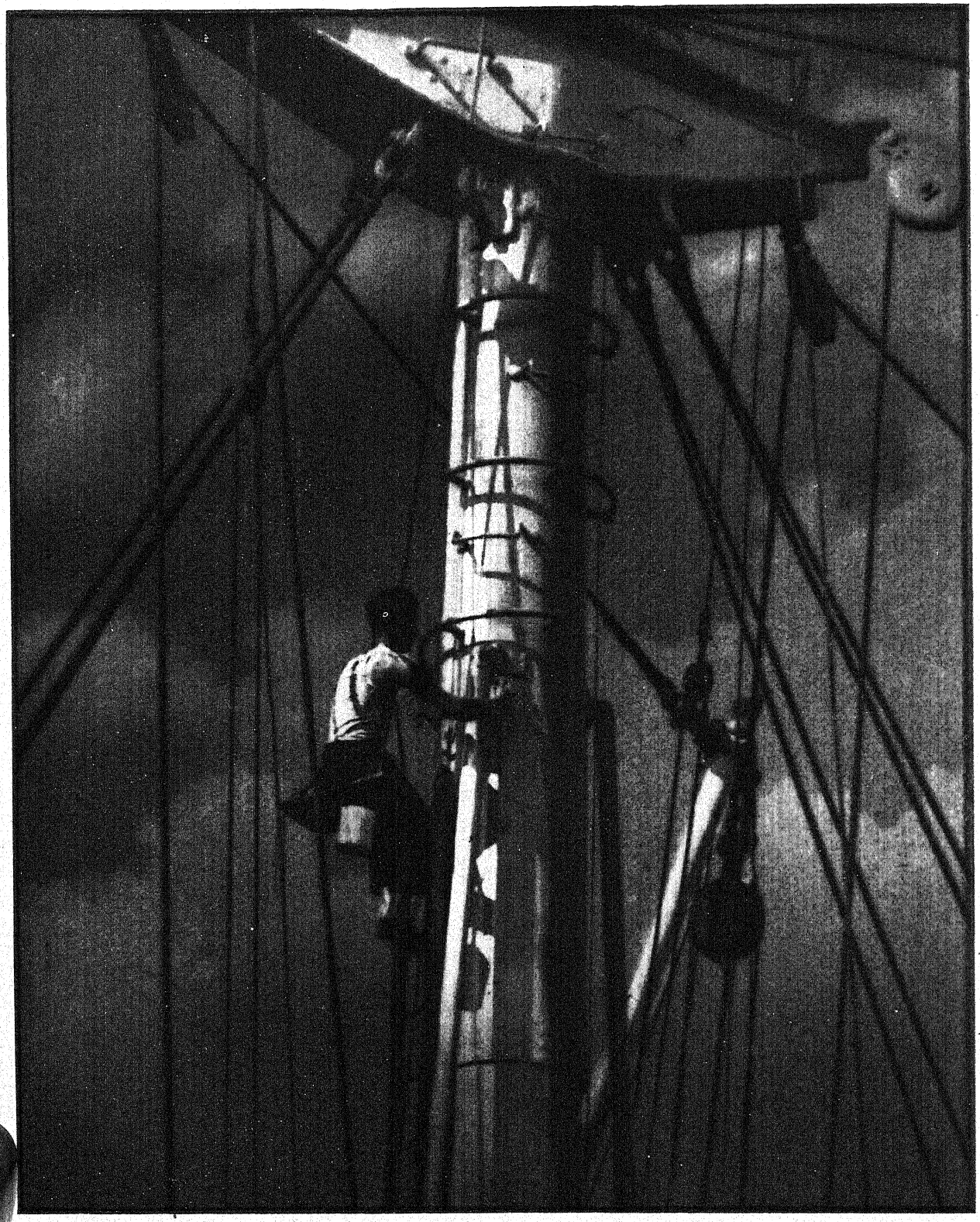
W. L. F. W.



THE SKIER

M. Le C

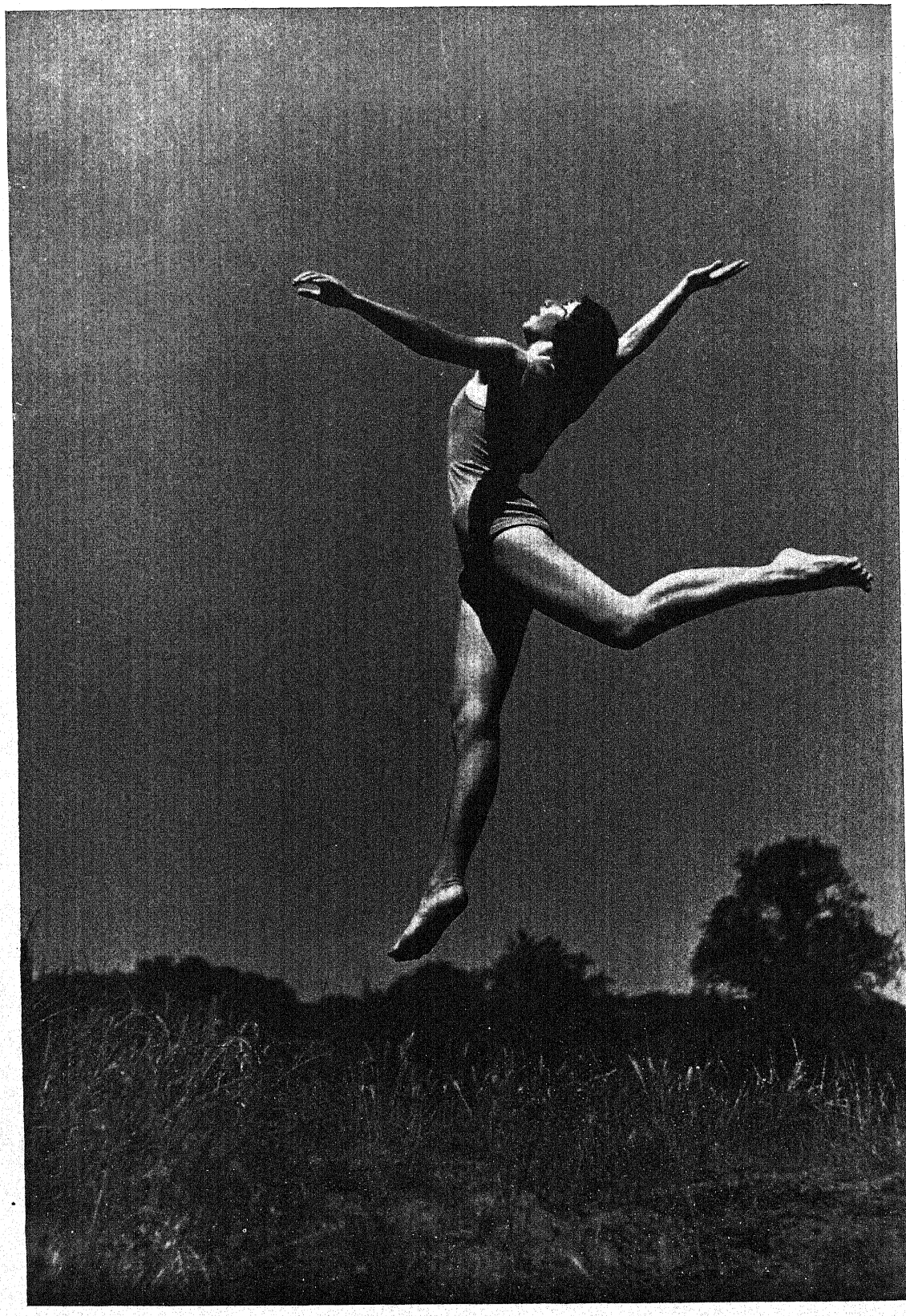
Compass camera, f3.5, Ilford Special Rapid panchro. plate, Wratten G filter, exposure 1/50 sec.



PAINTING THE MAST

S. J. Kharegat

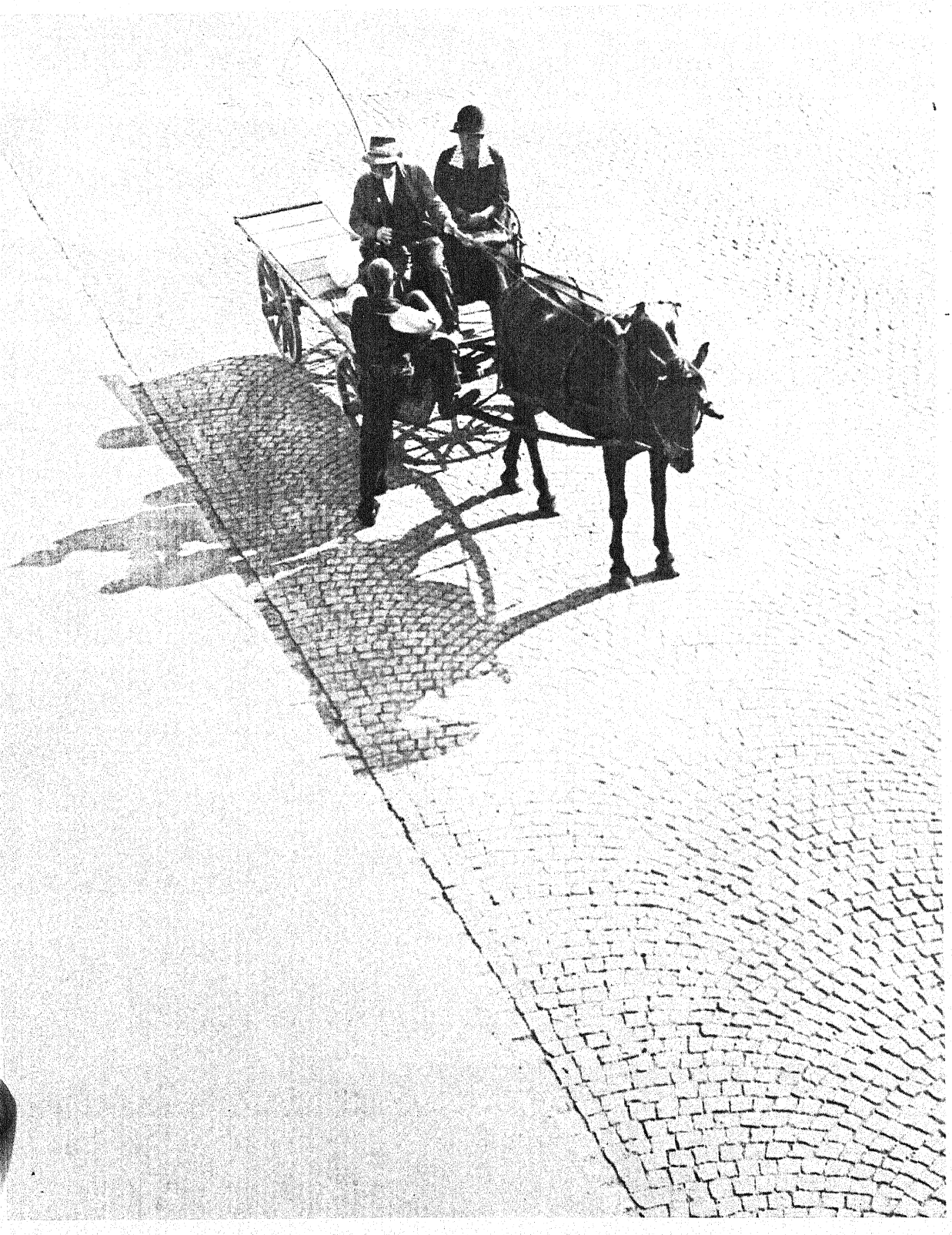
From "The Amateur Photographer" Overseas and Colonial Competition



JOIE DE VIVRE

R. G. Lewis

Contax camera, Sonnar f1.5 lens, exposure 1/200 sec. at f4.5



THE CART ON THE COBBLES John H. Ahern, F.R.P.S.

An example of Angle Shot photography (see also page 28 and article pages 70 to 73)

INTRODUCTORY : (2)

MODERN MAGIC OF THE AMATEUR CINE CAMERA

Gordon S. Malthouse

Editor of " Amateur Cine World "

Once a pastime for the few, amateur or sub-standard cinematography is now the pursuit of thousands of enthusiasts. With improvements in equipment and a wider understanding of technique, the scope of the novice in modern pictures is greatly increased. In this stimulating introductory article the basic difference is made clear between a film that is but a tedious series of incidents and one that is a story, however domestic. Economics of film-making are also considered. Introduced here, the subject is considered in full practical detail under various headings in this work, including Cinematography

THROUGH the magic of the cine camera the amateur can re-live, whenever he wishes, events that to other people can only be memories; he can faithfully record baby's charming little ways and watch her grow to adolescence; he can find solace in the moving shadows of friends who have passed over; he can experience again and again all the joys of holiday-making. And if he has wider interests he can find illimitable scope for the exercise of his imagination and interpretative skill in the production of films that have an interest outside the family circle. Many amateurs have produced films of civic events for local authorities, some have found fame in professional film production. One company, indeed, is largely composed of amateurs turned professional.

The Personal Film

It is natural that the beginner should suppose that a " personal " film, designed primarily for family consumption, should not need the same care in production as a film of wider appeal that may be shown to large audiences. As far as the " personal " film is concerned, he might well question whether there is any technique to be learnt at all, because it is so easy to take films.

Certainly it is easier than taking still photographs; the shutter speed is constant and one has only to set the lens to the desired aperture and press the knob that sets the clockwork motor going. Primed with no more knowledge than that to be obtained from a cursory perusal of the instruction booklet provided with his camera, the beginner can certainly take right away moving pictures that will doubtless give him very great satisfaction. But they will only be moving pictures—not a film, and when once the novelty has worn off he will be forced to admit to himself that there is something lacking in them. There is not one technique for a minor film and another for a major one.

Film-making versus Taking

If he is to *make* films, as opposed to merely taking moving pictures, he must learn to regard the cine camera as something very much more than a glorified box camera. With the latter he has taken photographs quite indiscriminately, snapping anything that has taken his fancy. Each snap is sufficient in itself and is judged entirely on its intrinsic merits. But in movie-making each single shot is not of interest primarily for itself, but only in relation to the other shots in the film. If a coherent film is to result, all of the shots that comprise it must, as it were, be welded together; each shot must advance the action in some way.

It is no service to one's friends to present them in a series of fragmentary, disjointed animated snapshots, it is a disappointment to oneself and a trial to the audience. Neither is there any skill in it, and where there is no skill there can be no real or lasting pleasure. The fascination of movie-making is in the construction and editing of the film. Pudovkin, the famous Russian film director, has said that editing is the foundation of film art.

Fakes and Impressions

The reel one receives back from the processing station is only so much raw material with which the film-maker builds up the personality of his friends—if it is a personal film; or the " atmosphere " of a locality—if it is a scenic film. And inevitably in building up this personality or " atmosphere " he expresses his own individuality.

The power he has of achieving all this through the manipulation of the separate film strips is quite startling. An incident can take on many quite different meanings



REVEALING CLOSE-UP. Completely natural action is the salient characteristic of this "still," which in a few feet of film could record a simple and amusing childhood incident and, still more, set the opening note for a lively domestic sequence
Photo, John H. Stone

merely by the alteration of the order of the various shots comprising it. For instance, if a shot of a tiger loping along is joined to a shot of a man running in the same direction, a dramatic situation results: a man being chased by a tiger. But if the order of these two film strips is inverted we get the farcical situation of the man appearing to chase the tiger.

In actual fact the man might never have seen the tiger in his life and may merely have been running to catch up with his wife. The audience assumes that he is running for his life simply because the separate film strips are in a certain order. Next time you see an African travel film in which an unfortunate native is pursued by some ferocious beast, watch carefully to see if both appear together in the same scene. If they do not, then you can be quite sure that the chase is faked and that it never happened at all.

The basis of cine technique is to show just enough to an audience to enable them to imagine the rest. But the beginner rarely gives his audience credit for much intelligence by inducing them to meet him half-way. He is invariably so intrigued by the novelty of the cine camera, by its power of capturing movement, of showing waves actually breaking, of baby actually walking—tentatively, and with many tumbles, but walking, nevertheless—that he tries to get everything on to his reel of film. Thus he uses far more stock than he need and his film cannot be other than disappointing. Indeed, it is not a film at all, but a series of incidents—a very different thing.

Economy for the Film's Sake

The novice, then, must learn to be economical in his film-making, not only—and not primarily—for the sake of his pocket but for the sake of the film. Just how he should husband his resources is fully explained in the articles on cine technique in this work, but one might well ask here: Is any hobby expensive that teaches economy? Many people who know nothing about cinematography but know what their still photography has cost them draw a comparison which is unfavourable to movie-making as far as the cost factor is concerned. But that is because the comparison is based on a quite untenable argument.

There are three sizes of non-inflammable sub-standard film: 8 mms., 9.5 mms. and 16 mms. A reel of 8 mms. that runs for some four minutes costs 10s., including processing.

The cost of the films in the larger gauges is relatively more. And yet the still photographer can get a spool of roll-film for 1s. 2d. for 12 exposures. But the fallacy of basing a comparison on *amounts* of still and cine film is apparent from the fact that in a reel of 9.5-mm. film, which, at a cost of less than 5s., gives a showing time of about a minute, there are more than a thousand pictures.

These pictures are not, of course, viewed separately, but still photographs must inevitably be. It must be borne in mind, too, that not only do cine pictures move, but that they are very considerably enlarged—from 1½ feet to 20 feet or so wide, according to the power of the projector. If the still photographer enlarged all his prints to these sizes the cost would rapidly assume a dimension to match. Again, colour film is a far more satisfactory proposition for the cinematographer than for the photographer; the latter must be content with transparencies, but colour cine film is projected in precisely the same way as monochrome stock.

Even so, 5s. a minute may seem to be an expensive rate. Count up to a minute without looking at the clock. You will have a much better idea of time than most people if your "minute" is more than 40 seconds. There are literally thousands of subjects that need no more than five minutes for their adequate expression: baby's bath, father gardening, John's perilous adventures on the rubber float, Joan's devastating shots at tennis. . . . If, however, one filmed such incidents in their entirety, keeping the motor of the camera running from start to finish of each incident, then quite conceivably they would take longer than five minutes. But the result would be boring in the extreme.

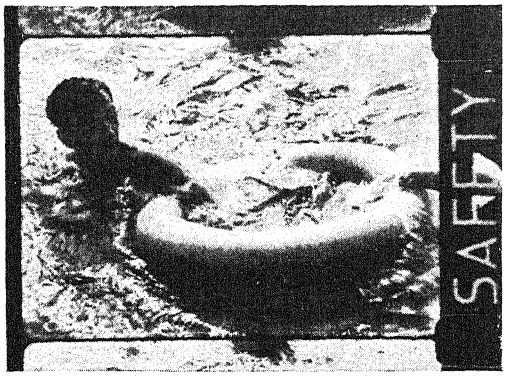
Five Years in Ten Minutes

The amateur movie-maker must learn to select. He must film only the salient features of a scene or action. By so doing he can compress the events of almost any length of time on to what, to those who know nothing about movie-making, seems a ridiculously small length of film. Thus, a record covering five years of baby's life can be very successfully produced on a reel of



LIGHT, SHADOWS, MOVEMENT. As with still photography, attention and care must be given to the effects of lighting in motion-picture making. The shadows seen in this beach shot impart a richness to the general scene and effectively build into a holiday scenario. The shot would be of great value as an introductory or continuity note in a well-edited film

Photo, Arthur B. Bishop



WATER GAMES. The scene depicted in this frame of "safety" film is typical of the kind of subject which the beginner is easily capable of recording with a sub-standard cine camera

Projectors cost from £3 or so to more than £100, as do cine cameras. It will be found an economy to buy the best one can afford. £25 will buy a thoroughly satisfactory outfit. The projector will enable the amateur to participate in the facilities offered by the film libraries, but the camera will give him a deeper appreciation of the professional films he hires from them, for if he is himself a producer, in however humble a way, he will the more fully enjoy the library film and this week's programme "now showing" at the local cinema. "Going to the pictures" is an altogether richer experience for the amateur cinematographer than for the uninstructed "fan." He will come in time to recognize subtleties of editing, nuances of direction, imaginative camera angles. He will have the exhilarating experience of creating such effects for himself.

250 feet, with a running time of less than 10 minutes. Needless to add, if the record is not to appear horribly scrappy the amateur must have a working knowledge of the technique of production, and it may be here remarked that it is this that it is the purpose of this work to supply.



CAMP CAMEO. Here is an example of a shot from a holiday film. Given plenty of variety in incident and adequate continuity, a film of this kind can be highly successful

To produce motion pictures one must, of course, have a cine camera, but one can be a devotee of amateur cinematography without one so long as a projector is available, for films for home showing can be obtained from the sub-standard cine libraries to be found in almost every important town in England.

These films are professional films which have been shown at the cinemas and reduced to the smaller gauges. Further, films of every event of national importance can be bought—news reels that will grow in interest and value proportionately as the memory of the events they record fades. With what absorbed interest we should view in our own homes a film of the coronation of George IV! With what rapt attention will our children see the film of the coronation of King George VI which we bought a week or so after the event and have carefully kept as one of our most valued souvenirs.

Whether he uses his cine camera merely as a pleasurable toy or as a social force (and the use of the sub-standard film in education, advertising and industry grows daily), he cannot fail to derive enjoyment and practical benefit from expressing his personality through the great new medium of the film.



DULY RECORDED. Another frame from the camp episode shown above. Shots like these must be timed within certain limits so as to avoid both the "flash" effect and monotony

HOW YOUR CAMERA WORKS

Starting with the sketches at the bottom of this page, this article gives, in diagram and picture, a complete summary of how a camera works and how the sensitive film responds to the action of light. The phraseology is as non-technical as possible, each photographic term introduced being made clear the first time it is used. The beginner wishing to understand how his camera takes its photographs will find this matter as instructive in the basic principles of all photography as it is interesting to study

See also Beginners, Hints and Tips ; Box Camera : Camera

THE first five illustrations (below) are diagrams showing a box camera in section with each principal part shown in sequence. In the following pages photographs demonstrate the simple operations necessary to handle the camera.

Diagram 1

The " film " on which photographs are taken is " sensitive " to light. The sensitive substance is coated on thin sheet celluloid. A lens concentrates on to it a small " image " of the scene in front. The bright parts of the image have much more " light-action " on the film than the dim parts.

But if other light reaches the film it will be acted on all over, and the details of the image will be swamped. So we put a box or " bellows " round to keep out unwanted light. The case also serves to keep the lens and film in position and to hold various helpful accessories, such as the view-finder and the shutter.

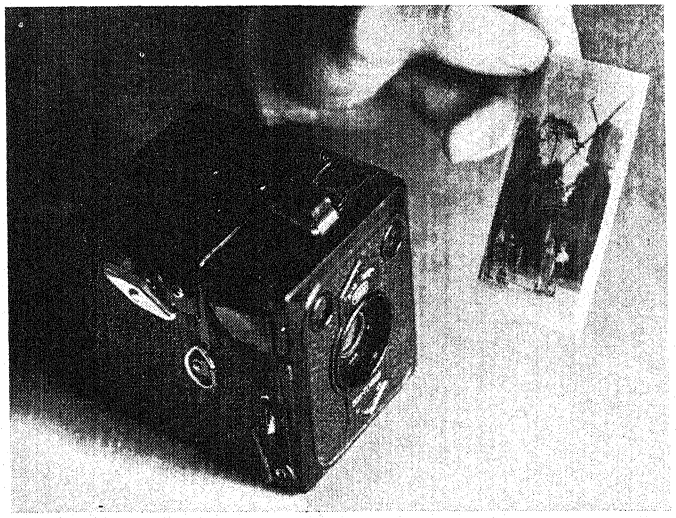
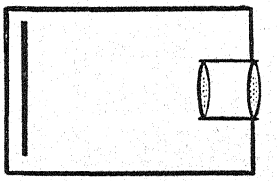


Diagram 2

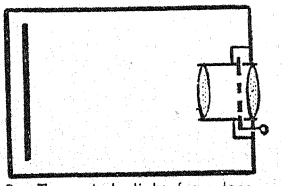
For instance, we do not want to let even the light from the lens which forms the picture or " image " reach the film, except at the right moment, and then only for the right length of time. So a device known as a " shutter " is fitted to it. This is usually in the " lens-mount," and it can be opened and closed when required to " expose " the sensitive film to the rays of light from the lens. When a small lever is pressed by a finger, the shutter opens and then closes again, so " making an exposure."

Diagram 3

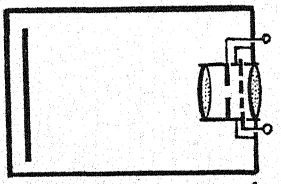
When the light is very powerful, as in midsummer, particularly at the seaside, it may be desirable to let less of it through the lens to the film.



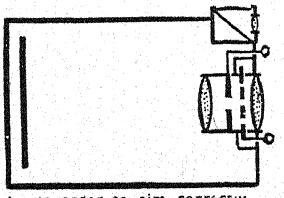
1. Lens projects image on film, box serves to exclude other light and hold things in place



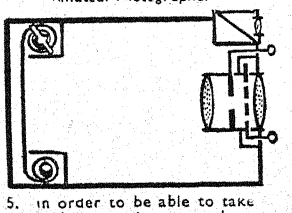
2. To exclude light from lens until required to form picture, a "shutter" is affixed to the lens



3. Variations in the power of daylight require " stops," which regulate the amount of light admitted



4. In order to aim correctly, we have a second, minute camera built in, called a view-finder



5. In order to be able to take more than one picture, we have a long strip of film

Diagrams and photos by courtesy of " The Amateur Photographer."

So we have a device to reduce the size of the aperture or hole through the lens, and so to stop some of the light. This device is called the " stop." Sizes of stops have special numbers. This device has other uses also, for the more advanced worker (*see* articles on Aperture *and* Depth of Focus).

Diagram 4

It is desirable to determine precisely what the camera is aimed at. But one cannot examine the image of the scene on the actual film, because to do so would admit unwanted light, and so spoil the film. So a duplicate camera of small size is built in, made so that the image is practically identical (except in size) with that which the big lens will give to the film. This device is called a " view-finder."

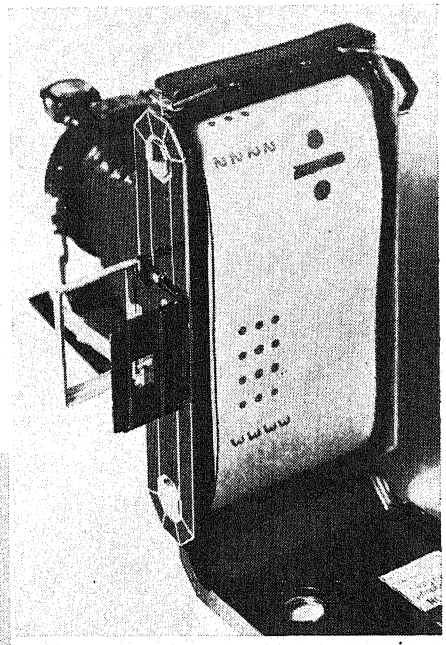


Fig. 7. How the film and paper lie in the camera. Note how each section is numbered

Diagram 5

We usually like to take more than one picture. So a long strip of film is wound, one section at a time, from one spindle on to another, across the back of the camera. After each exposure a fresh section is brought opposite the lens.

The following sequence of five photographs illustrate how the camera is handled by stages from the insertion of the roll-film to making a gaslight print from the exposed film negative.

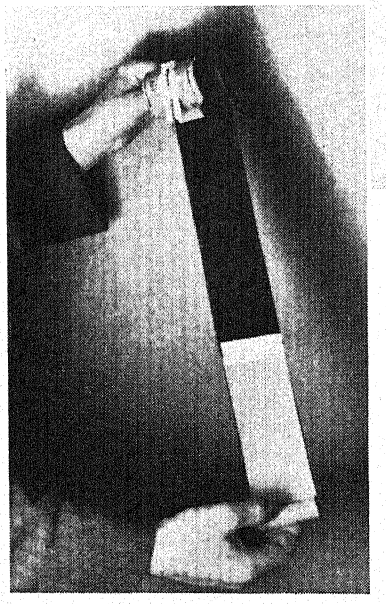


Fig. 6. The film in its backing-paper

Photograph 6

The strip of film is usually wound in a much longer strip of opaque paper to keep it dark whilst loading into the camera. The whole roll is called a " spool."

The outside of this paper is red (or sometimes green), while the inside, to which the film is attached by means of a piece of gummed paper or cloth, is black. The beginning of the film, and the gummed paper holding it to the black side of the " backing-paper," is clearly seen in the illustration.

Photograph 7

When the camera is loaded, the backing-paper is led from the original spool to a second empty one, and a few turns of paper are wound on. Then the camera is closed, and as the paper is wound farther it eventually pulls the first section of film into place behind the lens.

The opaque paper of the spool has numbers printed on it, which can be seen through a little red window in the back of the camera. This enables one to wind on a section of film accurately, and shows how many sections of the spool remain to be exposed. The sensitive film is situated on the other side of the opaque paper opposite the lens. But never open the camera like this except when the spool is completely wound up, because even the light which shoots around the edges will surely ruin it.

Photograph 8

When exposed there is nothing to be seen on the cream-coloured film. In a darkened room it is soaked in a chemical solution, called " developer." This " develops " the parts of the image into grey or black in proportion to the amount of light-action to which the various degrees of brightness in the image gave rise during exposure in the camera.

If the light-action was insufficient, the process of development will fail to bring up a strong image, and in the darker parts of the subject there will be areas where the film remains practically unchanged even after



Fig. 8. A film negative, developed but not yet fixed

development. This fault, which leads to heavy, detailless shadows in the final print, is known as "under-exposure," and is generally due to taking snapshots in too poor a light.

Photograph 9

Even then the film is still sensitive to light. But a second chemical solution, called the "fixing-bath," removes all the creamy substance which the developer has not darkened. Then the film is much more transparent, and is called "a negative," because the blackest parts represent the most brilliant parts of the picture, and the clearest parts come where darks in the picture caused little or no light-action.



Fig. 9. After fixing, the creaminess evident in Fig. 8 goes, leaving the film transparent except for the picture

Photograph 10

When the chemicals have been washed out with plain water, the film is hung up to dry, taking care that dust cannot settle on it, which would make white spots on the finished print. It is then pressed flat in a frame on a sensitive paper, very similar in nature to the film in its original state, though very much less sensitive ("slower"). Light is shone on the paper through the negative. Where the negative is clear, light has most action on the paper, and subsequent development produces the darkest tone. The denser portions prevent the light from acting so strongly on the paper, which therefore remains nearly white. These gradations of tone are shown in the diagram at the foot of Fig. 10, The result is a "positive" print, just like the original scene. This also must be "fixed" and "washed."

This description of the sequence of events and operations is kept as simple as possible for clearness, since it is an established principle that without a clear grasp of essential basic facts it is useless to attempt to acquire more advanced knowledge. Each of the operations and principles here presented is considered in the proper sequence of theory and practice in later pages of this work under the appropriate headings. Thus the novice is recommended next to read the articles under the headings "Beginners, Hints and Tips" and "Box Camera." He will learn from them how to handle the simple box camera in the regular pursuit of his hobby and how to make the best use of the film he exposes. He will also learn how to "see" a photograph before he releases the shutter, and many other things of value. From this stage he may proceed to more advanced and general articles as, for example, Camera, Composition, Backgrounds, Portraits, and many others.

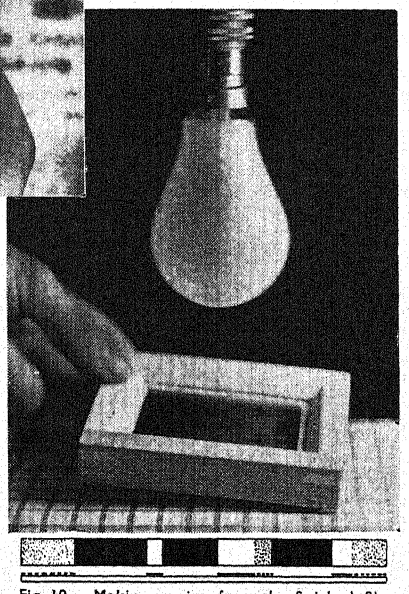
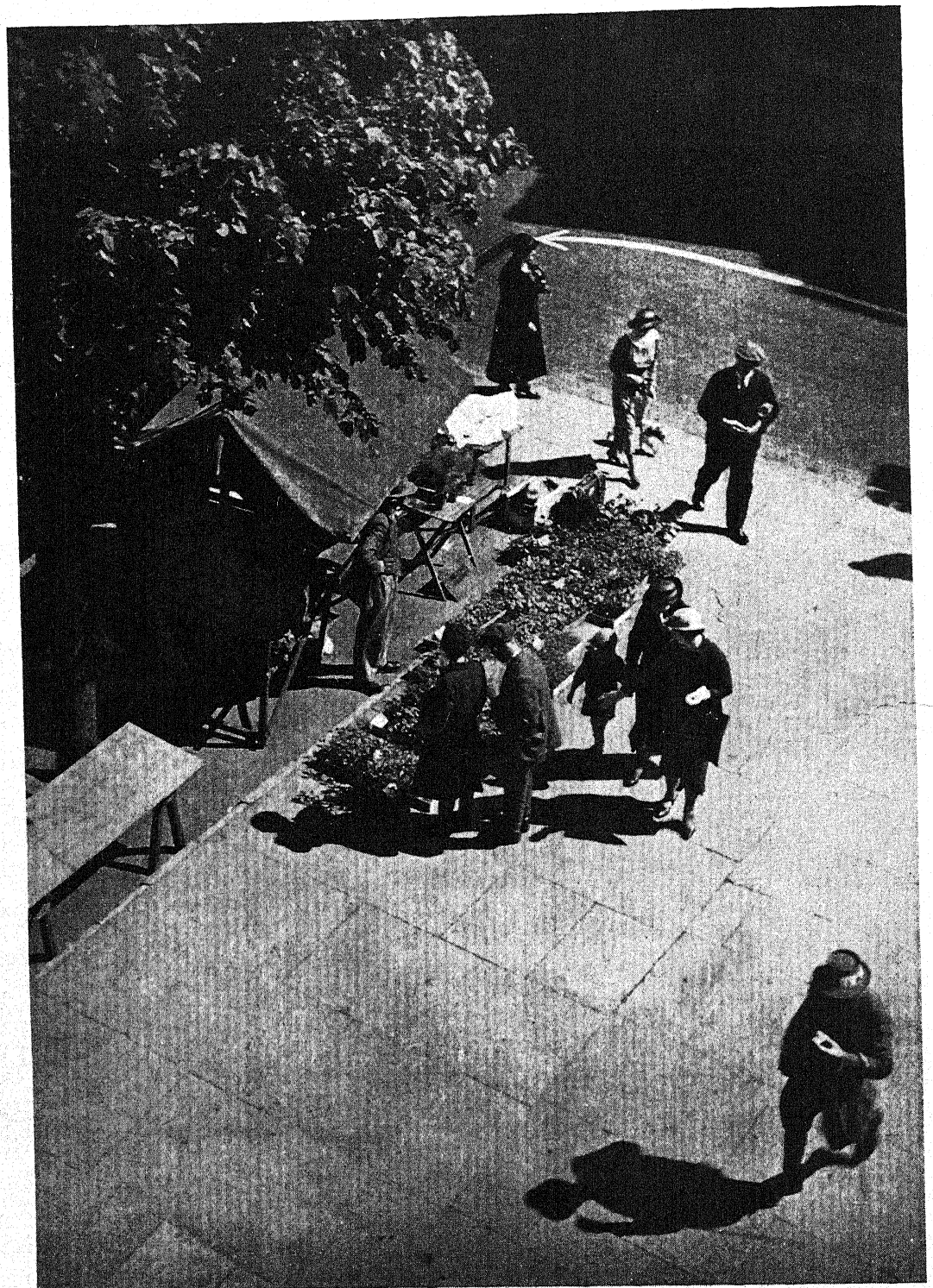


Fig. 10. Making a print from the finished film on "gaslight" bromide paper by the light of an electric bulb. The diagram shows density differences between high-lights and shadows after development and printing



MODERNISM. This angle shot with its high contrast is successful in conveying a suggestion of warm sunshine as well as spontaneity. Without the strong shadows the photograph would lack strength and vividness. It may be considered one of the most effective and natural results of the special point of view adopted by Mr. Ahern in much of his work. Another example is given in page 20

Photo, John H. Ahern, F.R.P.S.

THE MODERN ENCYCLOPEDIA OF PHOTOGRAPHY

ABERRATION. In optical science, aberration (which means literally " a wandering from ") is a term used to denote various deviations in the performance of a lens from an ideal standard of perfection whereby it produces an out-of-focus, distorted or otherwise untruthful image. Such defects are mostly due to the light rays which pass through the lens not coming accurately to a focus over the whole area of the plate or film. Aberrations (with the exception of distortion and flare) are minimized by using a small diaphragm with the lens, but they are usually only totally eliminated by adopting special forms of construction in the production of the lens. The various types of aberration are dealt with under the heading Lens.

ABSORPTION. The taking up of one thing by another. Absorption is a term which photographers use in two senses. First, it may apply to the absorptive properties of certain chemicals, as, for instance, calcium chloride and magnesium perchlorate (" anhydrous "), which possess the power of taking up and retaining atmospheric moisture. Again, the sensitive emulsion of plates and films is able to absorb small amounts of certain dyestuffs whereby varying degrees of colour-sensitiveness are conferred upon it.

The term " absorption," however, is more often employed in photographic science in an optical sense to signify the disappearance or suppression, partial or complete, of light rays in passing through a medium. When, for example, a beam of white light passes through a red glass all the differently coloured component rays of the white light except the red ones are absorbed by the glass, the red rays alone being transmitted. Similarly, white light passing through a blue glass has all its component rays absorbed by the glass except those of a blue colour. A medium which absorbs some light rays and passes none of them, as, for instance, a piece of wood or a sheet of metal, is said to be opaque. Some media which are opaque to visible light transmit non-visible rays freely. Thus a sheet of ebonite, 1/64 inch in thickness, whilst absorbing all visible light rays completely, transmits infra-red rays with very little loss.

When light rays are absorbed by a medium they are not annihilated, but are changed into another form of energy such as heat or the energy of chemical action. Upon this law the whole of photography rests, for it is the chemical action of the light rays absorbed by the sensitive plate or film which is responsible for the production of the photographic image.

It is well to remember that every object that we see manifests its colour (or lack of colour) in consequence of its absorption of the component rays of white light. An object which absorbs all the differently coloured rays of white light except the red rays, which it reflects, will appear red, and, similarly, an article which absorbs all the rays of white light except, say, the blue-green ones will appear blue-green to the eye.

If an object does not absorb any of the rays of white light, but reflects them back unchanged, it will appear white. Conversely, an article which absorbs completely the whole of the light rays that fall upon it appears black, since it reflects no light at all. If, finally, an object absorbs all the component rays of white light equally but not completely it will appear grey.

In some types of artificial lighting, such as the well-known mercury-vapour illumination, the light is almost entirely lacking in red rays. A red object seen under such lighting would appear black, for it absorbs all the available light rays and has no red rays to reflect. *See* Light.

ACTINIC. Light rays which cause chemical action as, for instance, that produced upon a photographic emulsion during exposure are said to be actinic. Actually, all light rays may be termed actinic, for it is now possible to obtain photographic emulsions sensitive to them. Non-colour-sensitive plates and films, however, are affected mainly by the light rays at the blue-violet and ultra-violet end of the spectrum, and it is to such

rays that the now somewhat arbitrary term " actinic " is chiefly applied.

No light rays are entirely non-actinic. Hence, it is as well to expose sensitive material as little as possible to even the " safest " of dark-room illuminations.

The actinic quality of daylight is normally a measure of the proportion of blue-violet and ultra-violet rays which it contains. When the sun is at its zenith in the sky, the actinic quality of daylight is at its maximum. It is at its minimum when the sun is low or heavily obscured by clouds, for under these conditions the blue rays are, to a large extent, absorbed and/or " scattered " by the atmosphere. It is, therefore, necessary to give a longer exposure to a plate or a film when photographing at such times.

It is practically impossible for the eye to estimate correctly the actinic value of light, and for this reason an exposure meter is an almost indispensable adjunct for the serious photographer, since it eliminates guesswork in exposure and thus lessens wastage of material.

Certain types of exposure meters which measure directly the actinic value of the light are sometimes termed actinometers or actinographs.

Of all artificial illuminations, those provided by the electric arc and the mercury-vapour lamp are the most actinic. *See* Exposure ; Exposure Meter.

ACTION SUBJECTS AND HOW TO TAKE THEM

Photographs that give an impression of life and movement are not readily secured unless the photographer has a knowledge of the particular requirements for the different subjects. Here is made clear what can be done with the simplest cameras as well as with those better adapted for such work. Faults to avoid with all types of apparatus are also discussed. A section dealing with cine work is included

See also Racing Photography ; Sports, etc.

To obtain successful action pictures the limitations of the camera must be fully considered. A wide-aperture lens and a high-speed shutter are essential for all-round work. Certain action subjects, such as trotting horses or athletics, can be successfully photographed in good sunlight with an aperture of *f*6.3, but for subjects like speedway racing or ice-hockey an aperture of less than *f*3.5 is of little use, and shutter speeds should range up to 1/1000 second for really fast work.

Let us first consider the case of horses. Good opportunities for picture-making occur at race meetings all over the country, point-to-point steeplechases, hunts and horseshows, as well as such annual features as the International Horse Show and the Royal Naval and Military Tournament.

If a picture containing a number of horses is required, a position should be taken up at the first jump. When the light is bad and a slow shutter speed has to be used, the camera should be as nearly in line with the direction traversed by the horses as possible and fairly distant, a small, sharp image being preferable to a larger one blurred by movement. Close-ups of one or two horses are possible, of course, but as a much wider angle of working will have to be adopted, owing to the risk of obstructing the horses, the exposure will have to be much shorter.

At a distance of about 15 yards, and at an angle of 45 degrees, the exposure required will be about 1/250 second. This speed is now quite commonly given on the Compur shutters fitted to thousands of roll-film and other cameras. A lens aperture of *f*4.5 should be used with this speed if possible, or an even wider aperture if the weather is at all dull. Pictures broadside-on



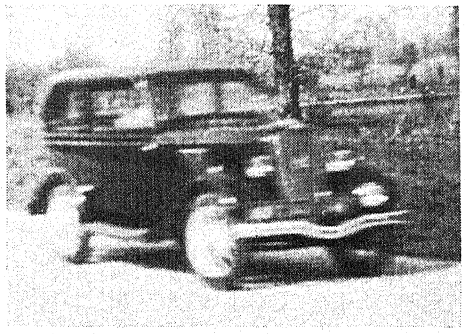
WALKING SUBJECTS. Two photographs of walking figures taken with different shutter speeds. Too much movement is visible in the left picture, taken at 1/20 sec. The other was secured at 1/40 sec.

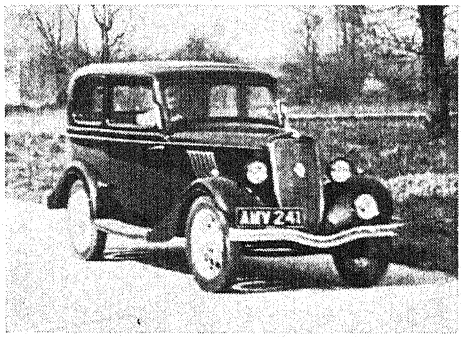
to the horses must be taken at a much greater distance and the highest possible speed used.

If a certain amount of blurring of the background is not objected to, it is as well to remember the press photographer's dodge of following the subject with the camera. This enables pictures to be obtained, even broadside on, with a shutter speed of 1/100 second or more. Some practice is, however, necessary for this, as it is rather difficult to time correctly the firing of the shutter while swinging the camera.

Besides photographs of jumping, many others equally interesting can be secured. There are the bookmakers shouting the odds, horses in the paddock being paraded by proud owners, and most of the usual scenes.

Snaps with Ordinary Cameras. Action snaps of running and jumping at school sports, etc., are frequently attempted by the amateur, but it is generally believed that to get this sort of picture a special type of camera fitted with a focal-plane shutter must be used if the images are not to be blurred. While this is perfectly true in the most exacting cases, quite good results can be obtained with an ordinary inexpensive camera if full advantage is taken of certain peculiarities that most moving objects possess.



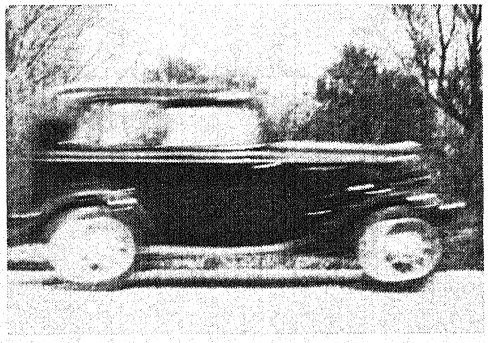


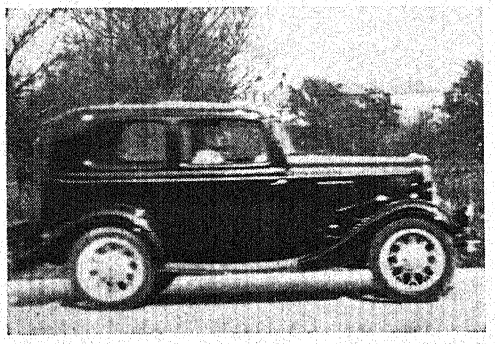
OBLIQUE APPROACH. The car in the upper photograph was snapped with a shutter speed of 1/200 sec., which gave a very badly blurred result. From an oblique position the speed of 1/500 sec., which was used in the lower photograph, gave the requisite sharpness of outline

It all lies in this question of movement during the time of exposure, for the slower the object is moving (or *appears* to be moving) the longer can be the exposure without danger of blur appearing.

Now, objects in motion have the characteristic of appearing to move at different rates according to the angles from which they are viewed; consequently it follows that if a position can be found from which the apparent motion is very small a much longer exposure can be used.

An object compared with an observer (or camera) is moving its quickest when broadside on—that is, passing straight across the field of vision—but the apparent speed steadily decreases as the viewpoint is carried round, until when the "end-on" position is reached (*i.e.* the object coming directly to, or going from, the observer) the relative speed is *nil.* The alteration in the object is now but a steady growth or lessening in size, which over a small interval of time like 1/50 or 1/100 second is virtually of no account.





BROADSIDE-ON. The 1/500 sec. shutter speed used for the upper broadside-on photograph shown was far too slow, the subject requiring a minimum of 1/1,000 sec. (as below), due to the right-angled position of the camera



GOAL-MOUTH SHOT. Ice hockey, the "world's fastest game," provides limitless opportunities to try the skill of the photographer. The shutter speed used in this photograph was 1/500 sec. on s.s. pan. film at an aperture of *f* 3.5

This means then that we have a far better chance of getting a good picture of races, etc., with a slow shutter if we "take" the runners nearly end-on and not broadside.

Also, the farther back from a moving object the picture is taken the sharper it will be. The results, of course, will be smaller, but if sharp they can be enlarged.

The nearer the camera is to the subject the more rapid must the exposure be to "freeze" the action. Consequently, double the exposure can be given at a range of 100 feet than at 50 feet without any greater danger of blur showing. For this reason, with a shutter that has no faster speed than 1/100 second, do not approach too near a fast-moving subject.

For the high and long jumps, etc., the above rule is applied, and, in addition, they have a law of their own which is possessed by all "to and fro" actions, viz., that at the end of one-half of the action there is a moment of perfect stillness before the return half of the journey starts.

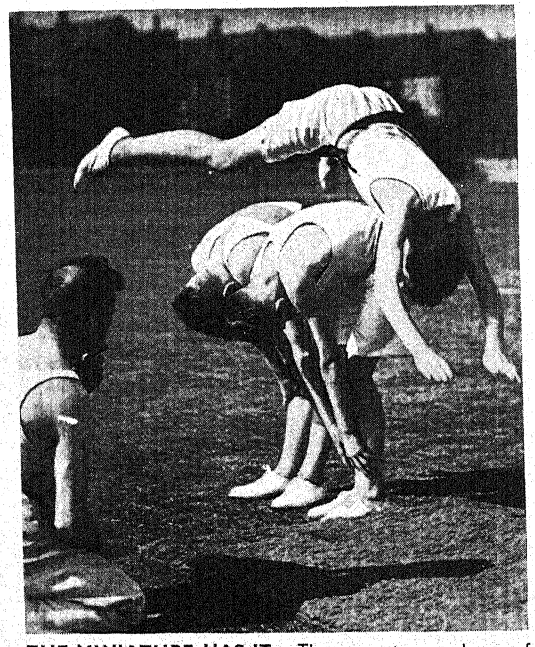
Thus a swing-boat goes up in one direction, then pauses for a fraction of time before beginning its downward swing.

A high-jumper in the same way goes up and up at a steadily decreasing speed till the top of the jump is reached; there is then a pause until gravity begins to assert itself, when the jumper comes to earth, the speed increasing at the same rate as it decreased on the upward journey.

The rule, therefore, for this class of sport is to place yourself "dead" in front of the jumper and well away, and then snap at the "peak" position. To spot the correct position is not as hard as it may sound if you watch a few jumps before exposing.

Ice-hockey is known as the fastest game on earth, and when it comes to photographing it the description seems adequate.

Ice-Hockey Snaps. An ice-hockey player, when skating as fast as he can, goes at a speed approaching 25 miles an hour. At this speed he can turn almost on a sixpence, so following him in an ordinary hand-camera view-finder is out of the question. A reflex camera provides almost the same difficulties, for the player is into and out of the mirror almost before the operator can press the button to get his picture.



THE MINIATURE HAS IT. The compactness and ease of handling of the miniature camera make it ideal for such subjects as that shown here. The exposure was 1/1,000 sec. at *f* 3.5
Photo, Bernard Alfieri, Jr.

The only view-finder worth using for ice-hockey shots is the eye-level direct-vision type. The finder used with the modern miniature camera is most suitable, and this instrument is actually the ideal camera. The depth of focus combined with the wide-aperture lenses now fitted to the Leica or the Contax, or similar apparatus, make them almost essential in rinks where the light is far from good.

As ice-hockey matches in Great Britain are played in the evenings, there is the difficulty of artificial light with which to contend. Only the most sensitive panchromatic material can be used, and the fastest films are found slow.



HIGH ACTION. In such subjects as jumping, where there is much repetition, the composition can be viewed to get the best effect before making the actual exposure. The success of snapshots of this type is largely dependent upon choosing the instant when the subject's motion is arrested at the highest point of the jump or other movement

Exposure 1/1,000 sec., f4.5, on rapid non-ortho. plate



HURDLES. This photograph of hurdlers in action, like the one above, was secured with a shutter speed of 1/1,000 sec. at f3.5

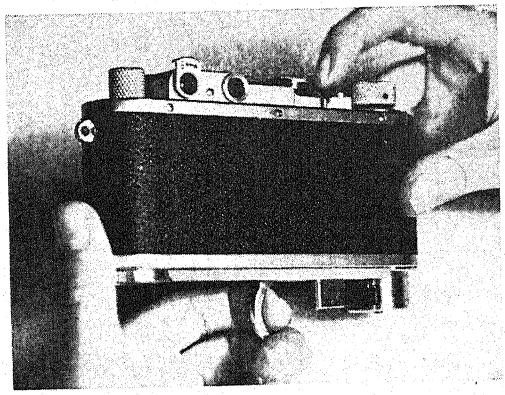
The widest aperture lens that it is possible to obtain should be used, and the camera focussed on some definite spot on the ice, somewhere just in front of the goal. The best shots are obtained from a spot just slightly in front of the goal at the rink-side.

Using the Miniature Camera. As already mentioned, unless the camera possesses very fast speeds, it is unwise to approach too near a fast-moving object. Small parts of the



LOW DOWN. A low viewpoint is frequently most effective in making a striking action photograph. The lively character of this picture is largely due to the low position and to the accuracy of the exposure as well as to the choice of full-on position for the photograph

Photo, Kodak, Ltd.

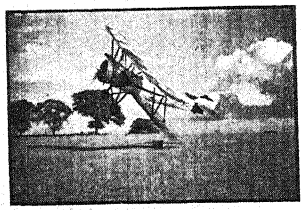


FOR RAPID SHOTS. The trigger device for operating the shutter and film-change mechanism on the Leica camera shown here is specially devised for fast action photographs
Photo, David Charles

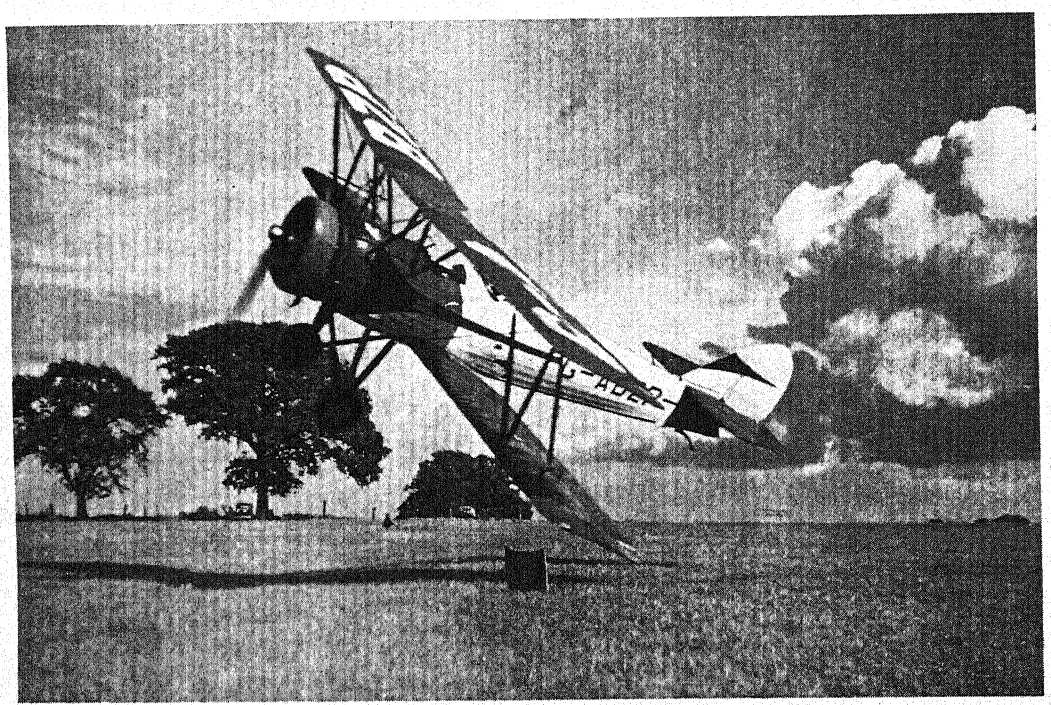
negative can always be enlarged if they are really sharp, and it is always easier to catch the incident from a moderate distance than rely on including the subject full size on the negative. A miniature camera is undoubtedly one of the easiest to use for very rapid shots, as, owing to the short focal length of the lens, a great depth of focus is available at a large aperture, and the shutter can be set at its fastest.

Any very rapid plates or films can be used, although it is a great advantage to employ super-speed panchromatic material. In actual practice it will be found that a good tone quality in a blue sky, sufficient to throw white sports clothes into relief against a grey background, will be obtained without the use of a filter. Where it is possible to make an exposure with the sun to one side of the camera, good modelling and a range of tone values can be preserved in the whites, which would be difficult if the so-called colour-blind films were employed.

A low viewpoint is often the means of obtaining a striking picture, particularly as it enables the subject to be taken against the sky, and gives an impression of height. With many of the sports events the effect of the composition can often be viewed before making the exposure, as in most cases there will be plenty of repetition. For this reason photographs of



Contact print of subject shown enlarged below



ORIGINAL AND ENLARGEMENT. This fine picture of a difficult subject, a low-flying aeroplane, was secured with a miniature camera with a pale yellow filter. The contact print is shown above on the right. A super-speed panchromatic film was used, and all the vital detail has been faithfully reproduced. Exposure 1/1,000 sec. at f2.
Photo, Bernard Alfieri, Jr.

high jump, long jump, hurdles, etc., are not as difficult as they may appear to the inexperienced.

A reflex or one of the miniature twin-lens cameras is very useful for the purpose, as it is a simple matter to rest it on the ground and focus on the top of a hurdle, a tape, or other centre of interest in the correct focal plane. It is then only necessary to watch a few competitors pass the spot to determine the best possible moment to make the actual exposure later on.



CLEAR-CUT ACTION. Photographs of this type can be taken without a high-speed shutter provided the highest point of arrested movement is watched for

ACTION SUBJECTS: CINE ASPECT

Notes on the use of the motion camera for rapid movements written by a cine expert

The principles which govern the making of motion pictures of action subjects are, in general, very similar to those prescribed for the still photographer; but there are certain notable differences. For example, inasmuch as the cine camera records the whole of an action the cine cameraman is not under the same obligation as the still photographer to watch either for the moment of comparative rest which occurs in some forms of action, or for the particular phase which best conveys the impression of movement.



SUBJECT FOR THE CINE. Sporting events in which there are always episodes and movement provide plenty of suitable subjects for the amateur who uses his cine camera with discrimination

Another difference concerns the shutter speed, for whereas the still photographer may require to curtail his exposure to 1/100, or perhaps 1/500, second in order to "arrest" movement and secure a clear-cut picture of a rapidly moving object, the

normal amateur cine camera is restricted to one shutter speed—usually about 1/30 second—at the normal rate of film-travel, and a certain amount of blur is inevitable in each individual " snapshot " or *frame* which goes to make up the film strip if the movement of the subject is too rapid to be " arrested " at the standard shutter speed.

It is not practicable, except in special circumstances, to quicken the shutter speed by increasing the speed of operation of the camera, because this has the effect of retarding the speed of action when the film is projected at normal speed.

On the other hand, a certain amount of blur passes unnoticed owing to the motional nature of the projected picture ; but when the blur is excessive the result on the screen is a travesty of the original action. This indicates the necessity for care in selecting the viewpoint in order to minimize the effects of too rapid action, and the cine cameraman may be guided by the same rules as the still photographer whose camera is not provided with ultra-fast shutter speeds.

In cine photography, as in still photography, viewpoint has a very definite influence on the *effect* produced by an action a low, frontal viewpoint tending to emphasize or exaggerate the action depicted, while a high viewpoint generally has the opposite effect.—*H. B. Abbott.*

ADAMS CAMERAS. Among professional photographers the firm of A. Adams & Co., Ltd., has long been known as manufacturers of finely finished studio cameras, sold under the trade name of Minex cameras.

The Minex studio camera is to a certain extent a departure from the ordinary type, inasmuch as it makes use of the reflex system of focussing, and, as the focussing screen is placed at the side of the camera instead of at the rear, the operator can focus and obtain the desired position of his sitter right up to the moment of exposure, all movements being controlled from the side of the camera.

This camera is equipped with both horizontal and vertical swing front, actuated by racks and pinions, as well as rising and falling front. The extension is of considerable length, so that long-focus lenses can be used.

The Minex reflex is a camera of remarkably fine workmanship, being constructed entirely by hand by expert craftsmen. The self-capping, focal-plane shutter is most efficient, and one turn of the knob sets both mirror and shutter, the latter being speeded from 1/8 to 1/1000 second. In addition, a pneumatic ball and tube with time valve is supplied, giving a further range of slow speeds—3, 2, 1, 1/2 and 1/4 seconds.

Other features incorporated in the Minex reflex are a revolving back, long extension bellows, and interchangeable lens panels, and, as the mirror can be locked out of action, very short-focus and wide-angle lenses can be used. A good rise of front is obtainable, and by means of a four-way swing front, which swings the lens on its optical axis, objects at an angle at varying distances can be brought into focus without stopping down.

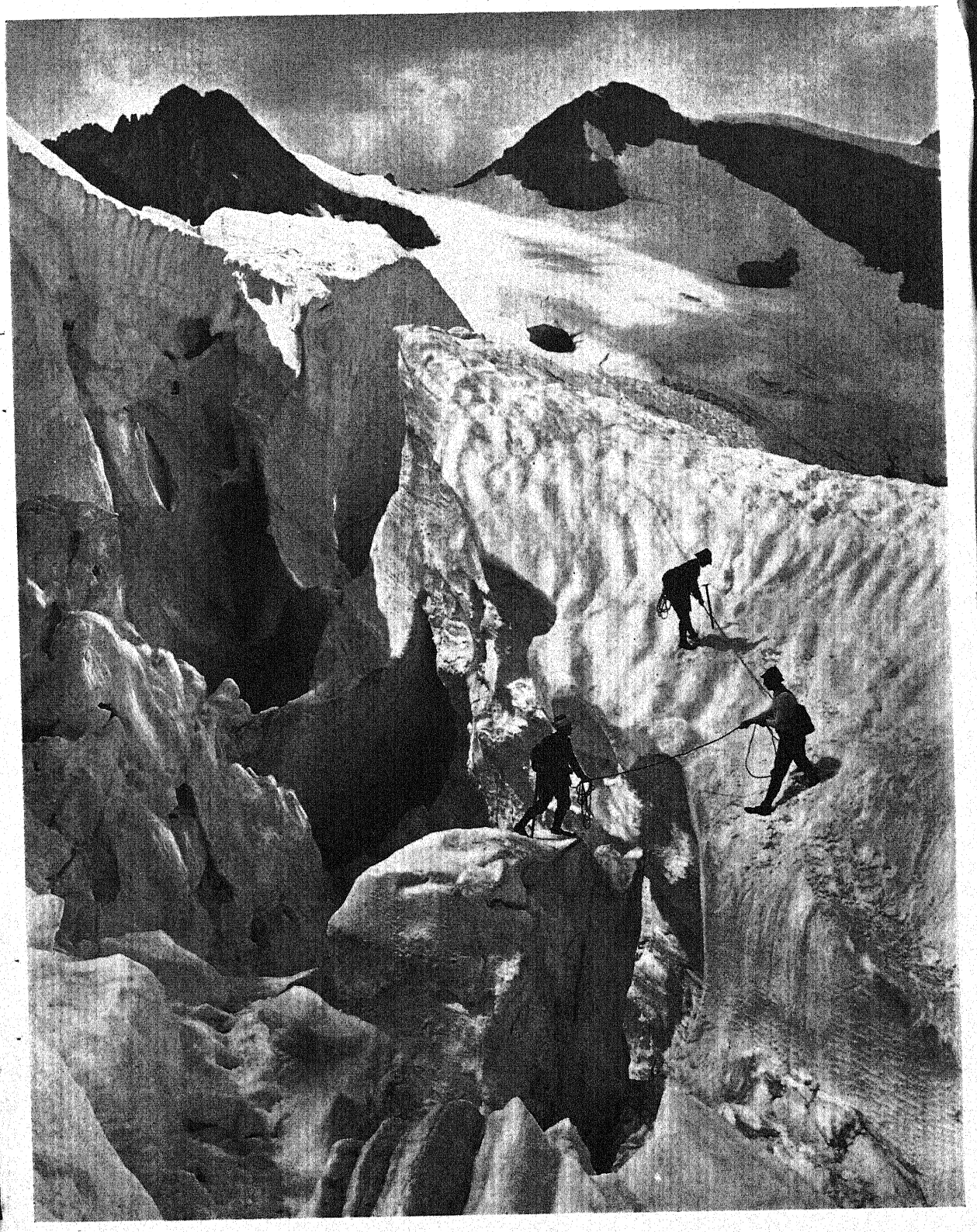
Other products of this firm include the Verto double-extension camera for roll-films and plates, the Vesta (roll-films and plates), the Vaido, a universal stand or hand camera, and the Minex vertical enlarger.

ADHESIVES. The best adhesive for mounting is that sold as photo mountant, of which dextrine is the principal component.

A similar paste mountant can quite easily be made at home as follows : Mix ½ lb. of the best white dextrine (the best quality only should be used) with cold water to make a smooth, creamy paste, taking small quantities of dextrine with a very little water and adding further dextrine and water as required. When the paste is thoroughly mixed, stir in 20 or 30 drops of oil of cloves or cinnamon, and 5 oz. of water.

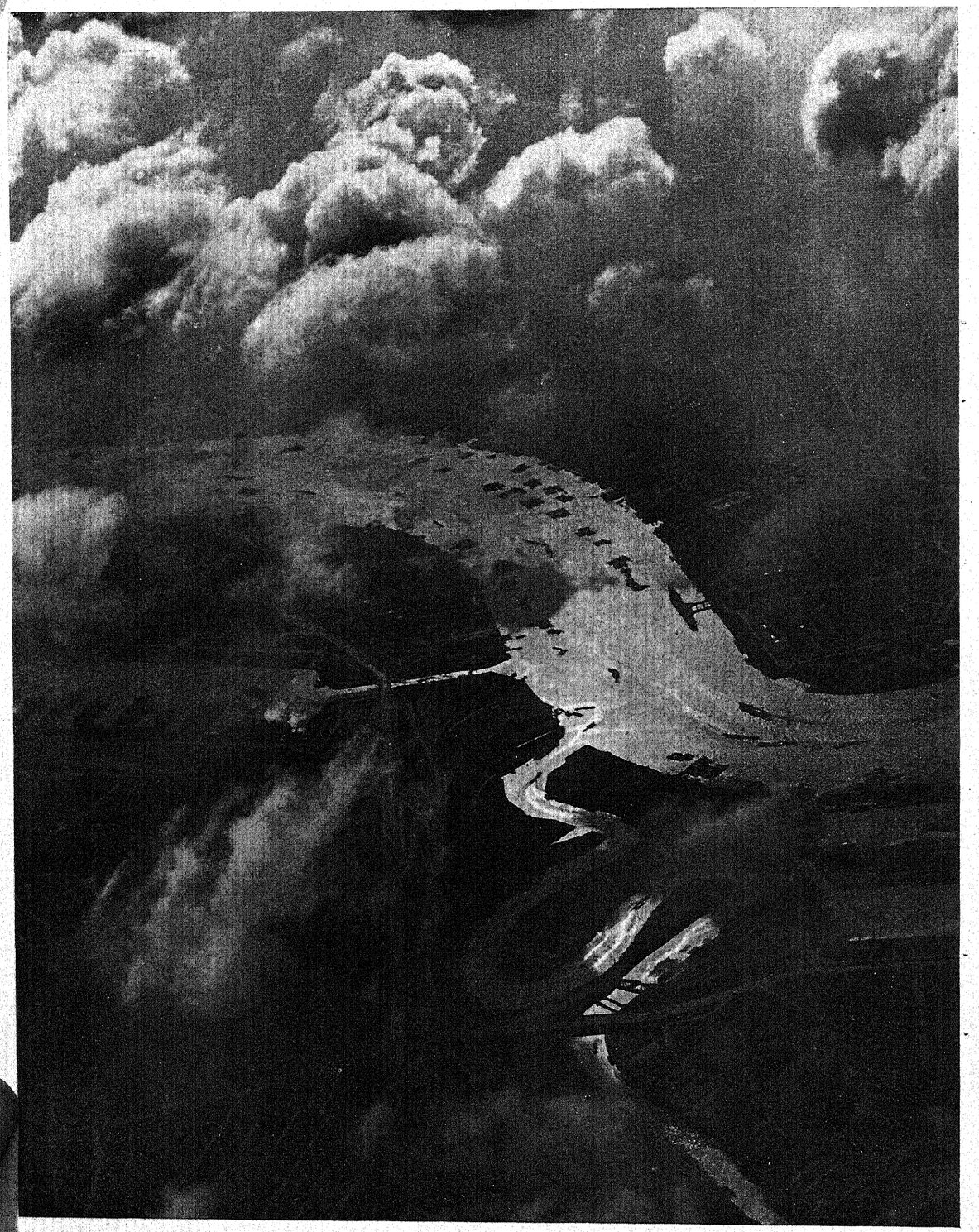
Boil in a clean saucepan until clear. Set it aside in a straight-mouthed jar, such as the white jars used for holding marmalade, to cool, and keep it covered. These mountants are very economical in use, and a small quantity on the tip of the finger or brush need only be used, rubbing it well into the back of the print. Other mountants are made of paste and arrowroot. Starch paste is made by mixing in a teacup a teaspoonful of pure starch-powder with cold water, adding the water a few drops at a time, until a stiff mass is formed. Add boiling water sufficient to half fill the cup, and on stirring the mixture will jellify. Let it cool, remove the skin which will have formed on the surface, and the paste is ready for use.

See Dry Mounting : Mounting.



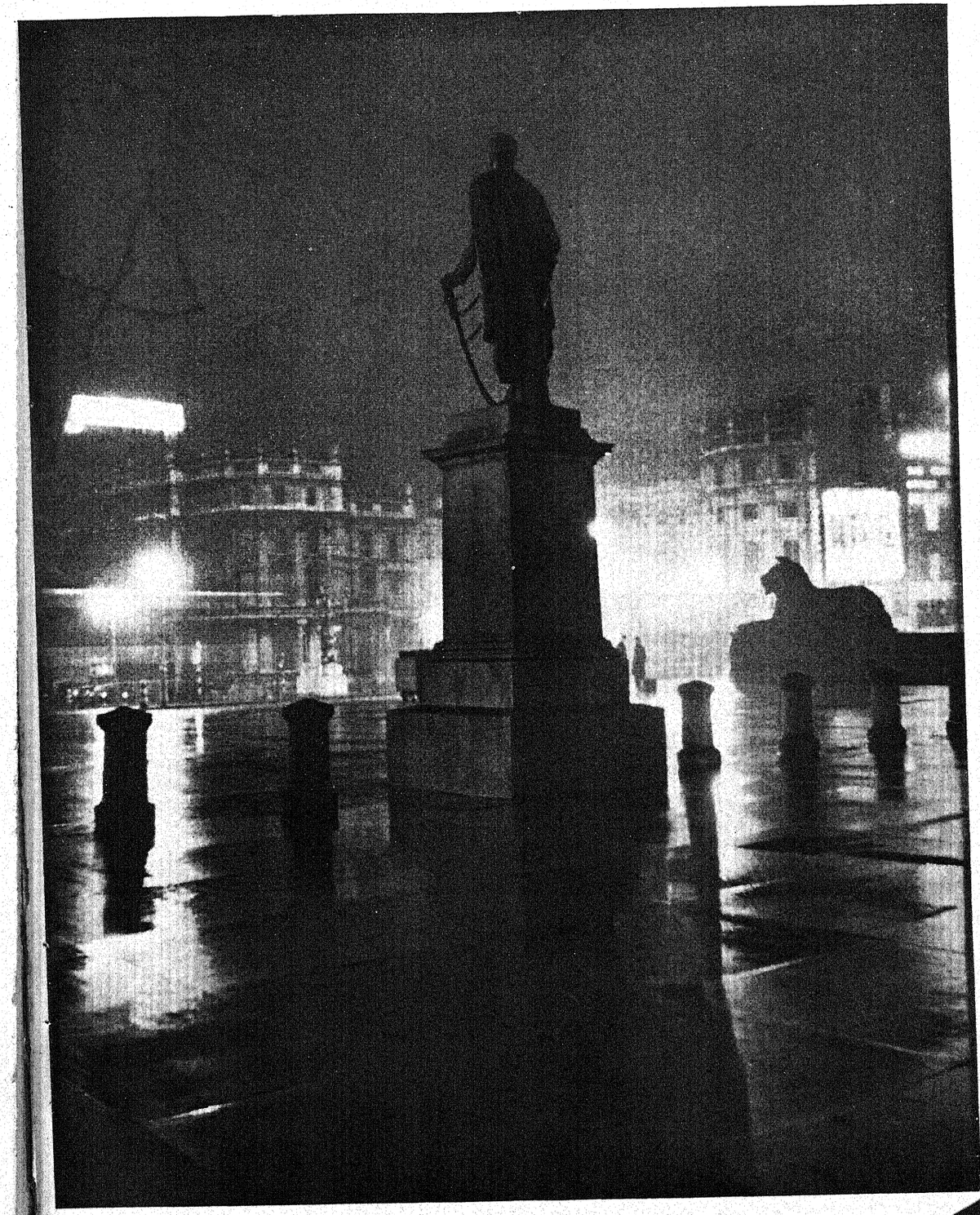
JUMPING A CREVASSE Donald McLeish

Taken on Ilford Monarch plate, f11 (see article Alpine Photography, pages 63 to 69)



THE PORT OF LONDON "Daily Mirror" photograph

Taken at 8,000 feet. An example of Aerial Photography (see article pages 50 to 58) with pictorial effect



TRAFALGAR SQUARE—A WET NIGHT

Compass camera, f3.5, Ilford hypersensitive panchro. plate. Wratten G filter, exposure 2 mins.



ADVERTISING PHOTOGRAPHY—A MANNEQUIN Studio Sun, Ltd.

Effective studio posing and lighting (see Advertising Photography, pages 41–49)

ADVERTISING PHOTOGRAPHY IN THE MODERN WORLD

E. Searle Austin

Editor of "Advertising Monthly"

No branch of commercial photography today demands more specialization than advertising, and the photographer who is engaged in this work must have unusual qualities if he is to be successful. What these are, why they are essential and how they can be utilized is explained in the following article, which deals with the subject from every angle

See also Commercial Photography; Industrial Photography

PHOTOGRAPHY for advertising has an entirely different set of values from portraiture or documentary work. It has, however, one factor in common with each: like portraiture, it must present its subject at its best or most effective, but it is every bit as functional as the pictorial record.

Function comes first, last and all the time in advertising photography. The photographer for advertising is not so much a camera operator as a creative salesman. His job is to emphasize the beauties and advantages of a product, to minimize its shortcomings (and this world produces little that is perfect), to create in the possible purchaser of the product a desire to possess it, to put forward arguments in favour of possession, breaking down sales resistance.

"But this," it may be said, "is the job of the salesman, not of the photographer."

It is indeed the work of the salesman, but he is only the vocal member of a team including copy-writers, commercial artists, photographers and other advertising men.

Function of the Photographer

The photographer's place in advertising can be quite easily defined. He is the specialist in one branch of advertising who is consulted by the general practitioner. A brief sketch of the structure of the advertising business will help to explain how his work must be directed.

The keystone of advertising is the seller, who is usually a manufacturer. As he may be an expert factory planner and producer of goods with little experience of selling, he often employs a sales manager and an advertising manager. The latter acquires an intimate knowledge of the product and gauges its probable market, and with this knowledge proceeds to plan his company's advertising. Usually, he calls in an advertising agent, who generally has little knowledge of manufacturing or the technique of handling travellers, but is well versed in the craft of couching a selling appeal and directing it at the most responsive areas of consumption. The agent, in turn, employs a series of specialist production men, whose function it is to know which is the best method of presenting a particular kind of written appeal. The production men either employ, or engage the services of, men who can best produce the style of work wanted.

Artist and Craftsman

Sometimes the manufacturer's advertising manager does without an agent, particularly if the advertising demands very intimate knowledge of the product, as in the case of highly technical matters. Then the advertising manager himself commissions work by writers artists, photographers and other specialists. It is clear that the advertising photographer must have qualities that even successful portraitists may lack. He must be able to co-operate with the advertising man, deferring always to the needs of the advertising policy and appeal, yet contributing practical suggestions on such matters as artistic approach and technical treatment. He is, therefore, an artist and a craftsman in his own right.

Drawing with Light

Photography today is not mere recording; it is drawing with light. It is an extremely sensitive and a fairly flexible medium, though in its application in advertising it is limited to half-tone reproduction, being denied the simplifying effect of line treatment. Within its limitations there is ample scope for variation, and present experiments with solarization indicate that its treatments may be further widened

Unquestionably, the growth in popularity of photography in advertising is due largely



A SIMPLE STORY. The subject and setting in this photograph are arranged with utmost simplicity to tell their own story—"Shoes for Beach Wear"—the maker's name being added
Photo, Alan March, Studio Sun, Ltd.

to the influence of the cinema, which has made the photographer's art at its highest comprehensible to the masses, whereas the artist with brush and pencil finds an appalling lack of appreciation of his medium throughout the whole range of society. Few buyers of mass-produced goods are art-educated; all of them respond almost instinctively to the photograph because they understand its meaning immediately. Every photographer who works for advertising should study the cinema, observing the film camera's selective skill, the lighting which controls and directs interest, and the general editing of the pictures which eliminates inessentials.

The Eight Classes. There are eight principal kinds of advertising photograph: reproductional, pictorial, fashion, scenic character, mechanical, explanatory and stunt.

1. **Reproductional.** This is commonly an ordinary good photograph of a product, without frills, but made interesting to look at by a careful selection of angle and dramatic lighting. Such photographs are used for motor-cars, furniture, tinned and bottled goods and similar commodities. Its main purpose is to familiarize the public with the appearance of the product, so that they will recognize it in shops and in use.

2. **Pictorial.** This kind of advertising photograph is much too common and often ineffective. It consists of a picture which by its subject or its atmosphere links up with the advertising; but often one photograph could be used for half a dozen different commodities equally well—or equally badly. The most familiar of this classification is the pretty girl's face, smiling. This may be seen in advertising for cosmetics, clothes, holidays, and a score of other commodities, and, with a cigarette stuck in the mouth, for tobacco.

Because of its lack of identity with the product it is a weak form of advertising.

Nudes often come into this category, and it is well to remember that a nude picture is "pure" if the model is not looking at the observer (subject, of course, to other obvious conditions), but that if the model is aware of, and looking at the observer, the sex element invariably obtrudes.

3. **Fashion.** This kind of photography is seen at its best in the high-class women's magazines. It has attracted some of the most brilliant advertising photographers all over the world, probably because despite the attractive nature of the subject it is an extremely difficult form of photography. It demands highly developed creativeness, coupled with a sense of dynamic composition, an ability to show a garment as it really is but at its best, and first-class technique so that the texture of fabrics may be transferred finally to the printed page.

The best fashion photographs look natural, but the garments and the models have been carefully arranged; that is one of the reasons why natural genius is necessary to the best fashion photography, for only superb skill can avoid that wooden look.

Despite all the work of the finest brains in the business, there is still room for men and women with new ideas, people who can capture the spirit as well as the look of a lovely gown or beautiful underwear. There is, however, no room for more hacks; the business is already overcrowded with them.

4. **Scenic.** Some excellent advertising has appeared during recent years in which the illustrative content has been a landscape or



ADVERTISING THE GOWN. Pose, lighting and background are cleverly chosen to show the vividness and effectiveness of the gown in this fashion picture. The heavy shadow throws the garment into relief and displays its style, while the texture of the fabric is plainly revealed

Photo, Dorothy Wilding



PHOTOGRAPHIC SUGGESTION. The carefree atmosphere of the holiday cruise is brilliantly conveyed by this informal publicity photograph with a very marked absence of artificiality and pose

Photo, Photographic Advertising, Ltd. Courtesy of Canadian Pacific Railway

seascape. A notable example of this is the Worthington Ale advertising, which shows England's beauty spots linked up in clever wording with the quality of the beer. Such photographs are also particularly good for travel advertising, for they show the object of travel. Nobody but another stationmaster is likely to be interested in a photograph of a railway terminus, but most people might be attracted by a picture of the beauties they would see if they allowed themselves to be persuaded to make a journey.

This branch does not demand so high a degree of talent as fashion work, but obviously an eye for beauty which will be equally good in black and white as in natural colour, a sense of composition and sound technical knowledge are essential.

There are plenty of opportunities here for amateur photographers to supply advertising people with pictures, but with certain provisoes that will be fully dealt with later in this article.

5. Character Photography. This is one of the most successful manifestations of the commercial photographer's art. It has presented us with such famous characters as Mrs. Rawlings of Reckitt's Starch, Old Hethers of Robinson's Barley Water, and Aunt Margaret who used so pleasantly to tell us the merits of Exide Batteries.

This branch of practice requires not only technical skill but artistic perception in the photographer and long-term planning by the advertiser. An advertising character does not become the public's friend overnight. Months and even years of frequent appearances in the newspapers are necessary before the public not only accepts the character, but is anxious to read what that person says. Such work is not, therefore, to be undertaken lightly, and it is impossible to take too much care in the selection and building up of the model who is to play the part. The usual method is for the advertiser to indicate the type he wants, approve the photographer's choice of model and make-up (if any is used), and for the photographer then to take at one sitting a series of shots which will last for several months.

Cost varies enormously, according to the amount of work involved and the eminence or otherwise of the model. A famous actress might command a fee of £40 for a sitting, while an ordinary model may be paid two or three guineas or even less.

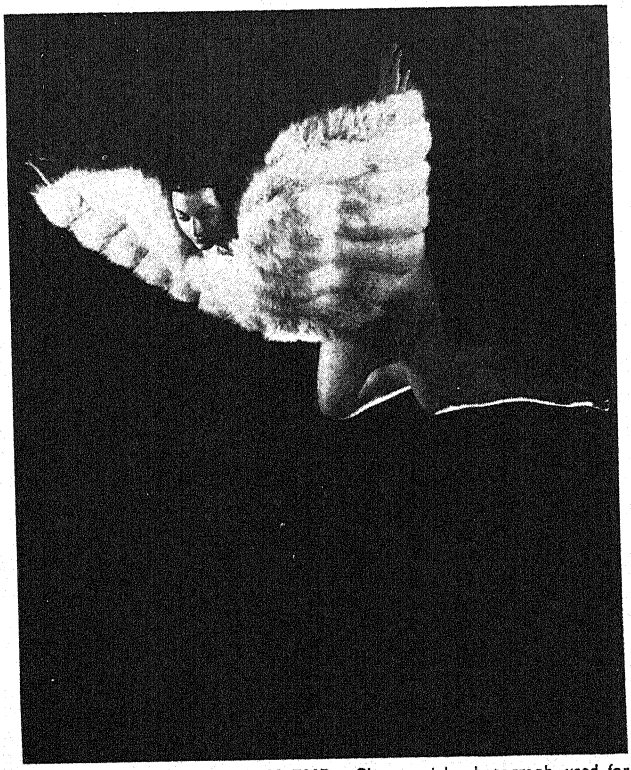
6. Mechanical Photography. This is highly specialized, for it is not every man who can represent a piece of machinery pictorially so as to show its construction, function and method of working. Though not quite so highly paid as some branches, an expert can be reasonably sure of a good income, for he can expect steady employment, as in this age of machinery there is a wide market.

Often a considerable amount of retouching is necessary on photographs of machinery,

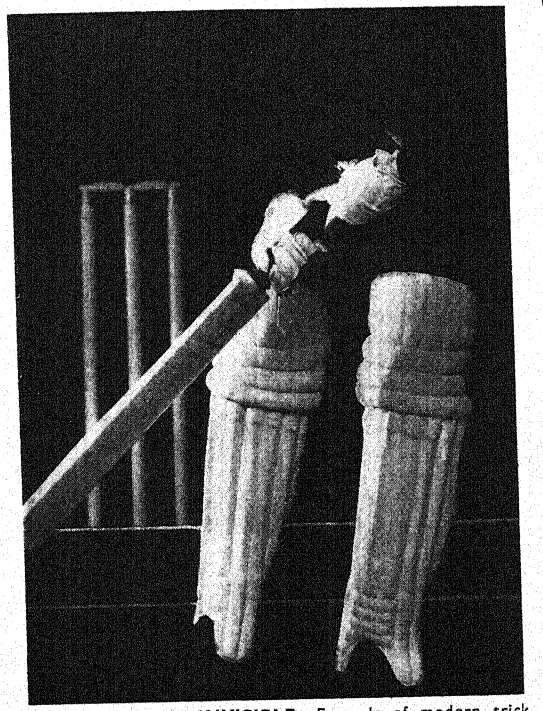
and the photographer who can get this done within his own organization is in a favourable position.

7. Explanatory Photographs. Used to demonstrate how a contrivance should be used, or how it works. A motor manufacturer's handbook, for example, often contains photographs showing the car owner how to assemble and dismantle the various components when they need adjustment; a vacuum-cleaner handbook shows the housewife how to empty the dust bag and oil the motor; a knitting pattern book will show the complete garment and parts of it in critical stages of its growth.

This work is not difficult. The client usually says what he wants photographed and all the cameraman has to do is to secure a clear picture of it. It is advisable, however, to learn how to present various materials so that their qualities are apparent—the brilliance of glass, the strength of steel, the elasticity of rubber, the sheen of silk, and so on.



A TRICK WITH FUR. Clever trick photograph used for fur advertisement. The model was posed in a prone position and the print was reversed in reproduction
Photo, Walter Bird
Courtesy of Swears and Wells, Ltd.

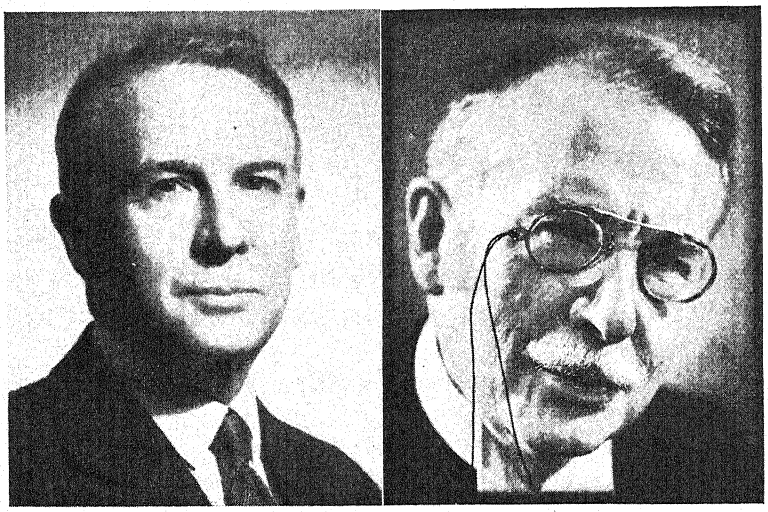


EFFECT OF THE INVISIBLE. Example of modern trick photography with "invisible man" effect produced by means of lighting and special exposure
Photo Tunbridge

8. Stunt Photography. This term covers a whole multitude of tricks, both mechanical and chemical. Double exposure and double printing are old familiar stunts for the combination of unlikely subjects, and the negative-positive is still successfully used.

The old idea that the camera cannot lie is quite absurd. The camera can lie most horribly, and often its ability to distort is deliberately employed. Pigs have been given wings and made to fly, queerly twisted faces have pointed out that bad radio valves can distort voices, and dragons have been shown climbing out of the Thames, dwarfing Cleopatra's Needle.

A later development is infra-red photography (*q.v.*), using plates sensitive to infra-red rays, which will penetrate mist and fog and thus enable photographs to be taken over enormous distances. As, however, the colour values are distorted by the infra-red



A PUBLICITY PERSONALITY Character photography is one of the most important branches of publicity work. Here are two photographs showing how make-up is employed to produce a type. On the left the subject is seen in his natural every-day presentation: on the right, his whole personality appears to be changed after make-up

Photos, Wormald-Vaus & Crampton, Ltd

process it has a limited application and may still be fairly classed as a stunt despite the technical erudition the process demands.

Leading photographers are now experimenting with solarization, a process which emphasizes certain lines in the picture and throws back others. The negative is exposed in the ordinary way, but development is a lengthy process involving copying and chemistry. The leading experimenters are keeping the details of their own methods secret, in the hope that, if one hits upon a result applicable commercially, he will have a monopoly.

Colour Photography. In its commercial application this has made great progress during the last three years. At its best it is superb, but accuracy can hardly yet be guaranteed. The Vivex process has been mostly used in this country. The photographer exposes the plates and sends them to a monopoly-owning company for processing, receiving back the finished prints.

Recently Kodak have announced the development of the dye process to a degree of quality and simplicity that cheapens colour work and brings it within the range of every photographer familiar with three-colour separation work. Briefly the process is this: Three negatives are obtained, one for each of the colour primaries, red, yellow and blue. These are taken either with a one-shot prismatic camera or by three exposures with filters. These negatives are used to make prints on to a relief film, which is treated so that it takes up transparent dye like a rubber-stamp pad. The red film is laid face down on prepared paper and weighted. The colour is transferred to the paper. The yellow film takes the place of the red and a second colour is transferred. This is, in turn, replaced by the blue film and the last colour is transferred, completing the tri-colour print.

With the development of colour printing, until recently inevitably expensive, the opportunity for colour photography will widen steadily, and young men in the craft should pay special attention to it. It is advisable, incidentally, to study reproductive processes so that the colour photograph can be kept within their limits and matched with them.

Past Phases and the Present Trend. Advertising photography has passed through several phases since it branched from its parent, portraiture. Some time elapsed before it threw off the hereditary influence. Then it kicked wildly over the traces and came under the spell of German designers, who were massing blacks in angular shapes. In an attempt to be "different," an art all by itself, it succumbed to the temptation of bird's-eye views, worm's-eye views, and sectional close-ups alleged to represent the whole, and stressed high lights and shadows, which was the camera's nearest approach to cubism.

Now advertising photography has recovered from its growing pains. It has reached maturity and become, anachronistically, a functional art.

In its present stage of development it prefers the naturalistic treatment with an interesting approach. The photograph looks

like its original, but careful choice of angle and subtle lighting draw attention to certain attributes. Action pictures are particularly popular because they do hold the mirror up to life, but not all outdoor photographs are taken in the wide open spaces. There is more sand in the studios of London than on the beaches at Brighton.

The Amateur in Advertising Photography. The photographer in advertising is no longer content merely to produce a pretty or a striking picture. His photograph now presents some quality or purpose of the product. It is in his failure to grasp this essential functionalism that the amateur photographer essaying an entry into the advertising field usually falls down.

It is a cold, hard fact that the amateur has no rightful place in advertising photography. Very rarely indeed is an advertising photograph the spontaneous thing that it seems. First of all it is part of a carefully built up advertising plan, a campaign that does not admit the intrusion of casual snapshots, however good—for the thread of continuity must not be broken. Then each photograph in a campaign is designed to do one particular job, to appeal to a particular emotion or break down an angle of resistance. It has been designed by the advertiser in collaboration with the photographer after hours of work, and only the photographer's skill makes it look as spontaneous as Brother Bill's snapshot at the fair.

Occasionally an amateur does get a picture good enough to justify an alteration of plan. An action snapshot, perhaps, or somebody using a product in circumstances sufficiently unusual to get attention. Views, children, quaint characters and animals may provide pictures that can be tied in with advertising. An almost classic example was the amateur photograph of a child and a Southern Railway engine driver.

If you think you have a picture an advertiser will buy, send it to the advertising manager of the company at the address given in his advertisement. Say how much



THE PUBLICITY STUDIO In modern publicity photography elaborate sets are often constructed in the studio in order to obtain accuracy and authenticity in the work. With a well-equipped studio the cameraman is well capable of producing big-scale scenes of the most convincing nature. Here a car is posed in front of a petrol station

Photo Studio Sun, Ltd.



FOR DOMESTIC PRODUCTS. The mother-love theme, as exemplified in this photograph, is capable of wide exploitation for advertising innumerable domestic commodities

Photo, Gordon Crocker, Studio Sun, Ltd.

you want for the picture ; if you don't know what to ask, remember that professionals get anything from five shillings to twenty-five guineas, and that most of them accept a fiver gratefully for an ordinary photograph involving no particular expense or brilliance. Remember always that you may not take a photograph of a man and do as you like with it. Always get permission in writing to do the specific thing you want to do with a photograph of anybody or his property.

There are two trends that are worth study. The more important is the combination of photograph and art work. In an advertisement there may be a photograph of the commodity with a drawn background or detail to create atmosphere, or to suggest the product in use. This idea has been developed by a London photographer and an art studio working in collaboration, and it is likely to be adopted much more widely.

The second is the application of the camera to the production of the strip cartoons which are so successful a form of advertising for products ranging from malted milk to deodorizing soap. One or two attempts have been made to produce the series of four or six little pictures by photography, not because the drawings are unsatisfactory but because so many people are using them. Actually nobody has yet produced photographic strips equal in clarity to line drawings, but several photographers are working with Plasticine and cut paper models and figures.



THE CHILD IN ADVERTISEMENT. Strip photographs, such as these, have proved extremely successful in advertising various products. Contrast and definite sequence are essential

Photos, Tunbridge

Equipment and Plant. The advertising photographer needs rather more equipment than the portraitist. He must have, of course, a good studio camera, but a field camera and one of the miniatures like Leica or Rolleiflex are extremely useful. These miniature cameras are not only small and thus convenient, but they are astonishingly accurate once their mechanism has been mastered. Skilful development of the film is necessary to keep the grain fine or enlargements will be useless, but with this care a 10 × 8 in. enlargement, or larger, can be practically grainless.

A wide-angle lens is also necessary, and when possession of a battery of lenses and several cameras is possible the lenses should be fixed to standard-size mounts so that they may be fitted to any of the cameras.

Enlargers and so on, of course, are as necessary as the floor on which the photographer walks.

The larger part of the advertising photographer's capital is invested in his studio. This is as large as he can get it, so that if necessary a motor-car can be photographed there complete with scenery. He aims at an equipped kitchen and bathroom, open to the studio, in which to take domestic shots. He also has means of lifting heavy pieces of furniture, gas cookers and other "props." These are either supplied by the client or hired by the photographer at so much per day from retail shops. Almost any store will hire out furniture and other articles at about 10 per cent. of their value.

His lighting equipment is the commercial photographer's pride and joy. He will have batteries of flood-lamps and spots, which he will use as the artist uses his colours. With them he creates high-lights and shadows, laying emphasis here, withdrawing attention from there. Nowadays most of these lights are gas-filled lamps, although some men still prefer the old carbon-arcs and whitewashed umbrella reflectors.

Dark-rooms are arranged for the speedy production of prints, for the advertising man has no long time such as the portrait man usually enjoys. It is essential, therefore, for the dark room to be efficiently and thoroughly organized and properly stocked. Unless efficiency is maintained, profits can dribble away with damaged negatives and paper, spilt developers and spoiled chemicals. Temperature has to be watched and regulated most carefully.

As plates may be exposed in cameras under varying conditions, development is not as automatic as with portraits taken with the same lights, lens and shutter speed. The dark-room operator must therefore be an expert.

Prints are usually required black and white on glossy paper so that all the detail is revealed. The advertising photographer rarely uses fancy finishes or tinted papers, because he remembers the factor which must never be forgotten, that advertising photographs are always reproduced as a series of dots, minute and varying in size or in depth of colour, and not as a continuous tone.



A NEW METHOD. This solarized camera portrait is an example of how special treatment can give power and unusual quality to an ordinary subject. This process, which gives the effect of an etching, is in the experimental stage and is described under its own heading

Photo, Greta Baun

AERIAL PHOTOGRAPHY: ITS PRACTICE AND SCOPE

F. L. Wills, F.R.P.S., F.R.S.A.

The co-operation of the aeroplane and the camera, which was brought to a practical stage more than twenty years ago, has now reached a high state of development. Step by step the use of aerial or air photography has been extended, and today it is recognized as a valuable science. Here the subject is fully discussed in an authoritative manner, and notes are included on amateur aerial photography

See also Archaeology

AERIAL or air photography has, in a comparatively short time, grown to be both an industry and an art. From being purely part of the equipment of war the air camera has become a most valuable instrument in commerce and science. The air pilot and air photographer, working together with modern, highly efficient machines, can make photographs for a wide variety of purposes. For the surveyor they can produce in a short space of time a complete photographic map, for the prospector they can give valuable information concerning uncharted territory, and for the archaeologist they can produce photographic proofs and clues of hidden relics of past ages. In forestry, town planning, publicity, and a great many branches of civil engineering, aerial photography now plays a big part. The flying photographer, armed with a new technique and with fresh and ever-increasing scope, has come into his own.

Panoramas from the Air

There are two types of air photographs: the oblique and the vertical. The oblique air view is taken by holding the camera in the hand, or in a mounting, at an angle of from 40° to 60° to the horizontal; thus a pictorial panoramic bird's-eye view is obtained. This form of air photograph is known to the man in the street as he sees it every day in his newspaper. It illustrates a typical or pictorial subject in a comprehensive and understandable manner.

In mapping from the air special cameras are used, and the pilot of the aircraft has to fly his craft in a special and very accurate manner. In Great Britain the camera in general use is the Williamson "Eagle." It is also employed abroad in many countries. This instrument is constructed entirely of metal and takes pictures measuring $8\frac{3}{4} \times 6\frac{1}{2}$ in. It is designed to accommodate a supply of film sufficient for making a large number of exposures without reloading. The film is carried in a magazine and, according to the type, from 100 to 200 photographs can be made without interruption.

For mapping purposes the camera is installed in the aeroplane with the lens facing downwards, so that vertical photographs are obtained. The various operations entailed in taking the photographs, such as setting the shutter and winding the film, are interconnected and interlocked in a gearbox so that incorrect manipulation is eliminated.

Means of Operation

The camera can be operated either manually or by mechanical or electrical controls. When operated by mechanical means, a small windmill, fitted to the side of the aeroplane, drives the camera gearing through a flexible shaft, and a Bowden control actuates the shutter for individual exposures and automatically re-engages the gear for resetting the camera.

When the camera is electrically controlled a small 12-volt motor is installed. This motor is linked up to the camera gearing by a flexible drive. As a protective measure a friction clutch is incorporated which transmits the drive under normal conditions, but slips in the event of any mechanical breakdown.

Special Louvre Shutter

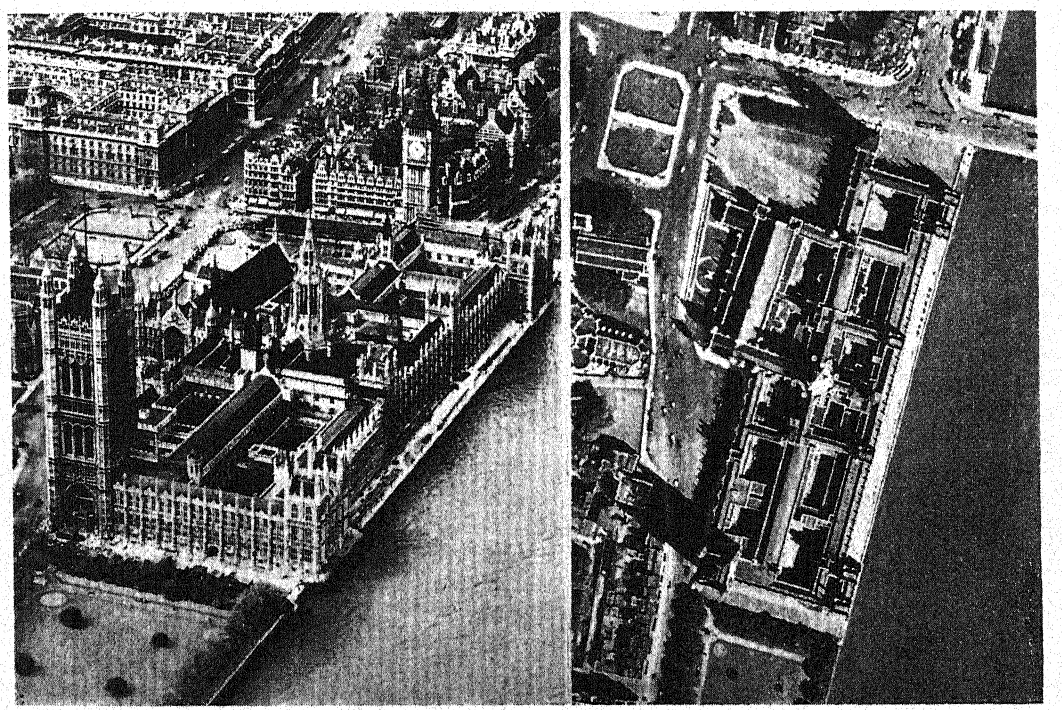
The shutter fitted to the "Eagle" camera is of a special louvre type. It consists of a number of thin metal strips which are assembled after the fashion of a venetian blind. All the strips or slats on one side of the centre of the shutter are made to rotate on their pivots in a clockwise direction, and the remainder turn in an anti-clockwise direction until they lie in a plane parallel with the optical axis of the lens.

It will be realized that when the shutter is open there are interposing strips of metal between the lens and the image ; it may be thought that this would detract from the photographic result, but as the strips are " edge-on " this is not the case, and one of the principal reasons for using this form of shutter is that it provides an even illumination over the whole negative. Another advantage is that the whole area of the lens is uncovered simultaneously, so preventing distortion of the image.

The film magazine consists of two aluminium castings which are locked together by a thumbscrew. The film is carried on metal spools which have a loading capacity of 165 feet. The unit fits on the back of the camera body, and it is fitted with a dial counter and a film action indicator ; two wheels are used which provide means for winding the film during the loading process and also resetting the counter.

The camera is mounted in the aircraft on bearers which are fitted with fine adjustments for levelling, and the instrument can also be rotated to correct for drift. To ensure absolute steadiness, felt and rubber washers are incorporated in the mounting so that high-frequency vibrations are damped out. Connected to the camera by electric leads is a unit known as the control box. This is usually fitted in the observer's cockpit and it gives complete control of the operation of the camera wherever it may be fixed in the machine. Moreover, various dials provide the operator with immediate information regarding the number of exposures made and the actual moment when the last photograph was taken. In one corner of the control box panel there is a green window which is automatically illuminated only when the shutter is being set. In another corner there is a red window, and this lights up five seconds before an exposure is about to be made ; disposed near these two lights are a dial and pointer which control the number of seconds between the exposures. This indicator is connected with a lamp fitted in the pilot's cockpit, and this serves to give the pilot five seconds' warning that a photograph is about to be taken. He is thus able to steady his machine at the moment the exposure is being made.

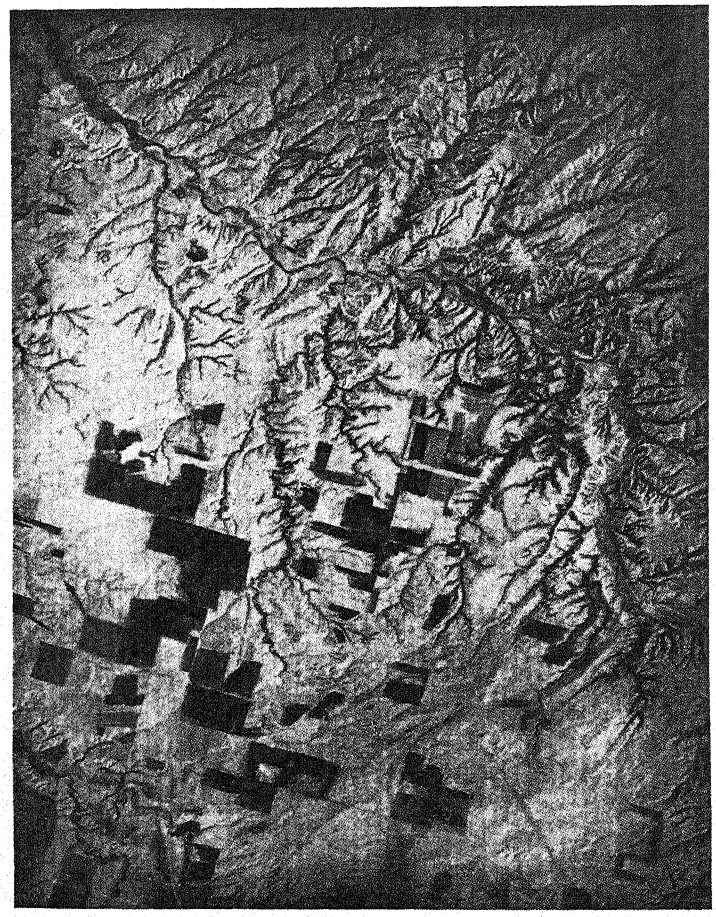
Built into the camera itself are instruments which indicate the height of the machine



DIFFERENCE BETWEEN OBLIQUE AND VERTICAL. The Houses of Parliament are easily recognizable in the left photograph, but in the vertical view (right) identity is more difficult. Shadows help in interpretation of photographs of this type

Photo, Aerofilms, Ltd.

4395



THE HIGHEST EVER. Taken from the stratosphere balloon "Explorer II" at a height of 72,395 feet, this amazing picture is the highest photograph yet taken by man. The area covered is about 105 square miles

Photo, Major A. W. Stevens. (Copyright, National Geographic Magazine, Washington)

when the photograph is made, the time of the exposure to the nearest second; a recording tablet for miscellaneous data, the serial number of each photograph, and the lateral and longitudinal levels. These are all automatically recorded on the margin of the film on each exposure.

Lens, Filter and Film. The finest type of lens, specially designed for air photography, is used.

Filters of varying colour and density are fitted to the lens, and cut out aerial haze (water vapour in suspension). They are used in conjunction with panchromatic film, and thus provide a faithful monochromatic rendering of the various colours of the earth's surface.

When an air survey is being carried out the pilot flies his aircraft at a pre-arranged height and a fixed speed. The height, of course, determines the scale of the photographs, and the speed must be constant in order that each successive exposure may record the area of the ground with a set degree of overlapping. The aeroplane proceeds over the site under survey in parallel lines and as it flies the camera is set in action. The photographs taken in sequence overlap each other in a forward direction by approximately 60 per cent., and each line of photographs overlaps the adjoining line laterally by some 30 per cent.

In order that the photographs thus made are of uniform scale the pilot must give the fullest attention to the handling of the machine. The amount of tilt must not exceed two degrees, and in a like manner only a very small variation in height during the operations is permissible, or faults will occur.

As has been said, the height at which the survey aeroplane flies and the focal length of the camera's lens control the scale of the photographs taken; they also govern the area of the ground covered. For this reason various types of lens are used on the "Eagle."

The scale used in maps is known as the Representative Fraction. For a scale of 1 inch to 1 mile this fraction is 1/63,360, which means that 1 inch on the map is the equivalent of 63,360 inches on the actual ground. When Ordnance Survey sheets of 1/2,500 scale are being revised by air photography, it is usual to make the photographs with a scale of 1/5,000 and afterwards enlarge them to the Ordnance scale. The production of photographs of this scale entails the use of a 20-inch lens and flying at a height of 8,333 feet. Clear atmosphere and good weather

conditions are naturally essential to the air surveyor; there must be no clouds in the vicinity of the operations, for not only would these obliterate the landscape, but their shadows would appear in the photographs and make interpretation difficult.

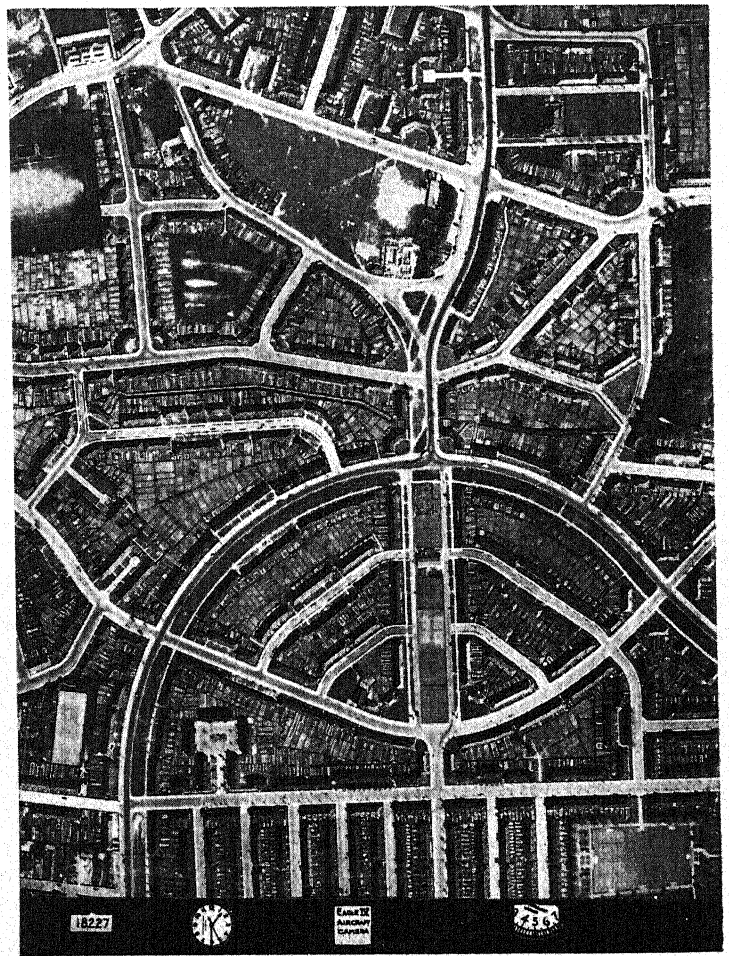
As soon as their day's work has been completed by the flying personnel the films are taken from the magazines and developed. Contact prints are then made and roughly laid together so that a check is obtained to see that the area has been properly covered. The photographs so produced will not be ready-made plans, for there will be variations of scale due to varying ground contour, and small discrepancies due to slight tilts that will have occurred while the exposures were made.

These imperfections are removed later by means of a special enlarger by which photographic prints are prepared to any desired scale.

This work can be carried out by a number of methods. One is to select on the negative and corresponding Ordnance sheet four or more ground-level points visible on both, and to pin-prick them through the negative. The film negative is placed in the apparatus and the image is enlarged and projected at the required scale of the standard 25-inch Ordnance plan. This projection is focussed on to the corresponding Ordnance sheet, which is fixed to a plan table. The table is tilted and the sheet is moved on it until the pin-points on both the image and the sheet coincide. With the scale corrected and the "tilt" thus rectified, the photographic paper is put into position and prints are made. In vertical photographs a true plan of the area is provided only when the ground is perfectly flat, and photographs of undulating country are bound to contain variations of scale, of course, because the scale applies to one contour only, as will be readily understood.

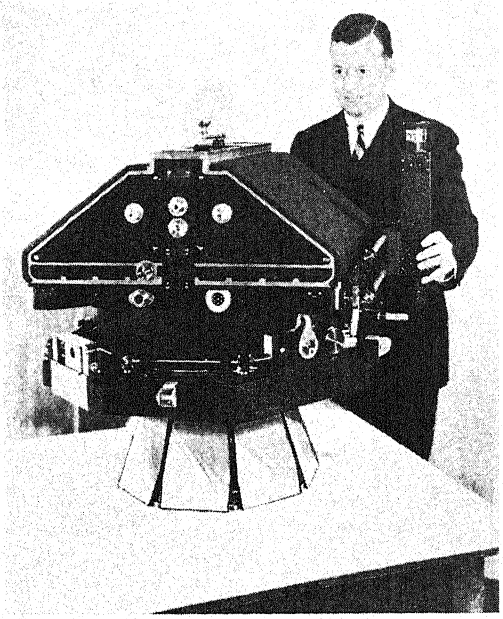
These scaled photographs may be joined together to form a complete photographic map, and, as such, prove a valuable supplement to the line map. The mosaic map should be considered as a picture plan of the areas.

Only training and experience give accurate interpretation of air photographs. Buildings are distinguishable from similarly shaped patches by the shadows, and roads, railways, footpaths, hedges, etc., are easily identified. Knowledge of photographic



DIRECT PHOTO LARGE-SCALE PLAN. A vertical photograph taken with a Williamson "Eagle" camera from an aeroplane flying over part of Tottenham, London. Such photographs are used in preparing plans

Photo, Aerofilms, Ltd.



WORLD'S LARGEST AIR CAMERA. This huge Fairchild aerial camera can photograph 600 square miles at one exposure from an altitude of 30,000 feet. It has nine lenses and nine electrically-operated shutters. The diagram shows how the nine prints are laid down

Courtesy, Fairchild Aerial Camera Corporation

colour values is important in that it assists one to differentiate the numerous ground textures and what they represent. This interpretation is made the more accurate by the use of the stereoscope, and this is a development which has undergone considerable advance in recent years.

The 60 per cent. forward overlap of each photograph mentioned earlier is provided in order that every point on the surface of the ground appears on at least two photographs, and so may be studied in its three dimensions with the aid of a stereoscope. The ground has the appearance of a solid model, and the undulations, trees and buildings are all seen with fascinating realism. One method of revising existing 1/2,500 plans is to trace from the scaled enlargements the outlines of new buildings, roads, fences, etc., with the aid of a steel stylo, carbon paper and tracing paper laid under the photograph.

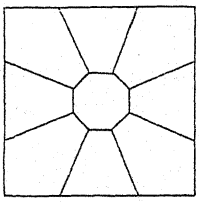
Every detail is first examined in the stereoscope before tracing. The tracing is laid on the plan, after the out-of-date detail has been erased, and the new work is traced and fair-drawn on the map.

By mapping one means the construction of topographic and cadastral maps.

These are constructed from air photographs on such widely differing scales as 1/250,000 and 1/1,000, hence it will be realized what a large scope is covered by a so-called " aerial survey." As well as providing material for the cartographer, data are available to the experts in preparing geological, soil, forestry, and other types of economic surveys.

If a pair of vertical photographs with the 60 per cent. overlap are examined in a precision stereoscope, the contour can be drawn on the photographs. When set in the instrument the heights, hollows and slopes of the ground are seen in relief, and their character can be judged.

The British Barr and Stroud topographical instruments are used for contouring in this and other countries. They provide a method, sufficiently accurate, which involves only a small portion of the cost of the elaborate automatic machine plotting methods used by other countries.



By printing in complementary colours one over the other the stereoscopic overlapping portion of air photographs covering the same ground and observing through colour spectacles supplied for the purpose (with red filter in front of the left eye), an impression of a well-defined plastic model of the ground will be seen.

A similar method is used in the Zeiss-Aerotopograph and other plotting machines. The two images are projected together and flash alternately on a screen. The images are observed through filter spectacles and the contour line for any height is traced, as by moving the screen up or down the height is changed so as to correspond with the various features of the model.

Multi-Lens Cameras. In all branches of air photographic work the United States has always shown a very progressive outlook, and American equipment and technique are of a high order. The immense size of the territory in Canada and the U.S.A. and the favourable atmospheric conditions have contributed towards the advancement of air survey in that continent which offers so wide a scope for the science. The same remarks apply also to Australia and South Africa.

One of the most remarkable air cameras so far devised is the American Fairchild single unit instrument. This camera consists of three main sections. These comprise a film magazine, a body fitted with nine vertical *f*4 lenses, and an assembly of eight astronomical stainless steel mirrors.

The film used is no less than 23 inches wide and is 200 feet long, sufficient for a hundred exposures. The lenses are arranged with one in the centre and the remainder are distributed round the sides. The mirrors, which are surface-plated with evaporated aluminium, are disposed at an angle, and their purpose is to increase the coverage of the eight side lenses. As will be gathered, the object of this elaborate camera is to make possible the photographing of a large area at one exposure, and it is said that a single photograph will take in 600 square miles from an altitude of 30,000 feet.

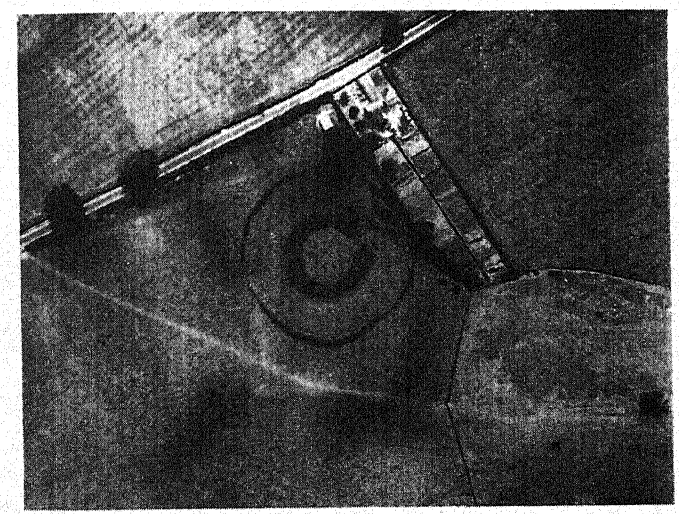
The multiple-lens camera developed in this country is known as the Barr and Stroud 7-lens camera. This camera covers an angular field across the flats of 120° by the use of one vertical central lens and six lenses placed symmetrically round the centre working through prisms which deflect the optical axis obliquely through 45° and produce oblique pictures. The lenses are Ross Xpres *f*4 of 53-mm. focal length. The lens fitting is attached to a Williamson " Eagle " Type III camera, and the resulting negative image, consisting of seven sections, is produced on a standard roll of film 5½ inches wide, and up to 125 exposures are taken with one magazine load. Printing is carried out in a special rectifying enlarger, when the six oblique pictures are rectified simultaneously to the plane of the central vertical image.

From, say, 15,000 feet, it covers nearly 100 square miles at a scale of about 1/70,000.

Lens manufacturers at home and abroad have now developed very wide angle lenses to cover by a single lens an angular view of about 95°. The wide-angle lens camera is thus much simpler in construction than a multi-lens camera, and the cost is reduced. These types of camera are used for reconnaissance purposes and the production of medium- and small-scale maps of undeveloped country. In air survey work the oblique photograph as well as the vertical type are extensively used. Where a rapid reconnaissance is required the former is particularly valuable, especially for plotting maps of small scale.

The oblique photograph can also be used for recording the extent of areas that become flooded where rivers overflow. Another use of oblique air views is found in providing municipal councils and committees with graphic illustrations of territories undergoing building extensions, and so forth. A record of the progress of public works construction at regular intervals is possible by such means, and town planning reports are now frequently illustrated entirely by a series of oblique aerial photographs.

Earthworks from the Air. One of the most fascinating spheres of air photography is in connexion with archaeological research. As long ago as 1891 attempts were made in India to take photographs from a free balloon for this purpose, and in 1906 an archaeological air photograph was taken of Stonehenge, also from a balloon. These early efforts, however, were merely experiments, and it was not until after the Great War that the air photographer and the



CIRCLES IN THE GRASS. But for aerial photography many ancient sites would lie hidden. In this photograph of Bridge Meadow, near Old Lakenham, Norfolk, the dark rings indicate an earthwork not visible on the ground

By permission of the Air Council.-Crown Copyright

archaeologist co-operated sufficiently to secure really striking results.

Oblique and vertical photographs taken at the correct height and under the right conditions reveal an astonishing number of features to the expert archaeologist. Destroyed earthworks—as, for example, ditches and ramparts—can be detected and traced over an entire site.

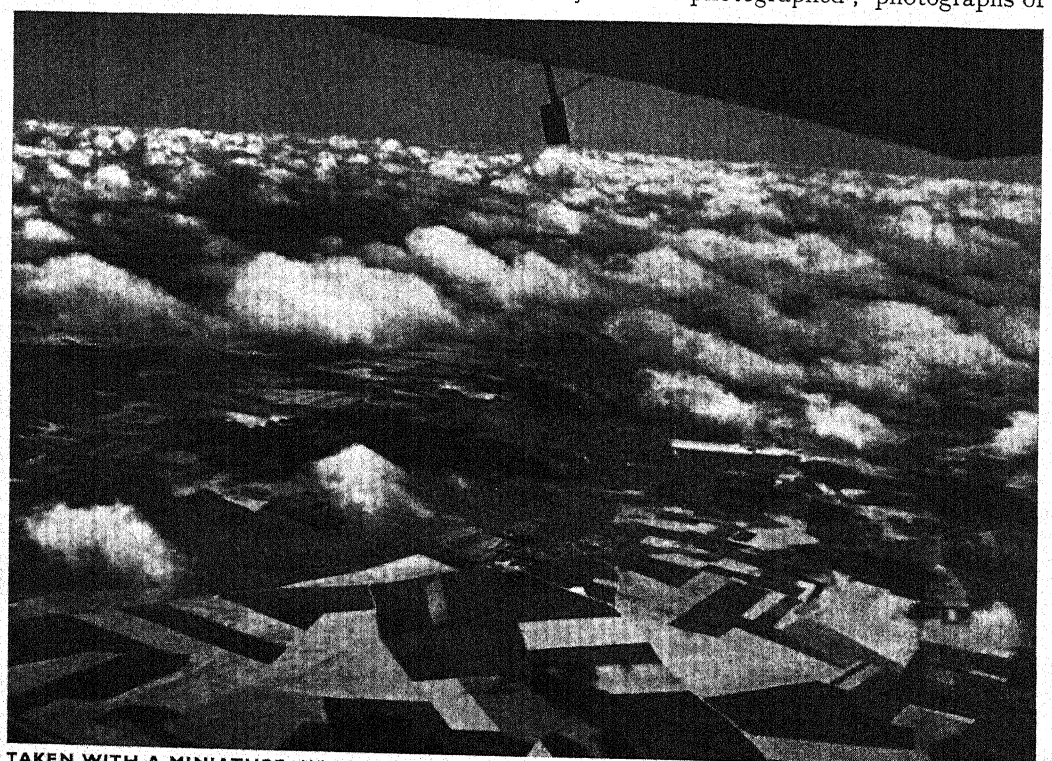
Sometimes the air camera reveals something that has never been noticed before. As an example there is the Bridge Meadow, Old Lakenham, Norfolk (*see* previous page). An air photograph showed the existence of an ancient earthwork which was indicated by two dark green grass rings outlined against the lighter coloured grass. There is the further case of the Trundle, a Celtic city on the famous hill that lies near Goodwood racecourse. Within the prehistoric circular earthwork, which has long been an attraction for archaeologists, there exists a ring much older than the outer rampart, and it was the air camera that led to its discovery. Excavations were carried out after the photograph had been studied, and it became clear that the ring was a remnant of the Stone Age, marking an encampment that once stood on the site about 2000 B.C.



Contact print of air view enlarged below

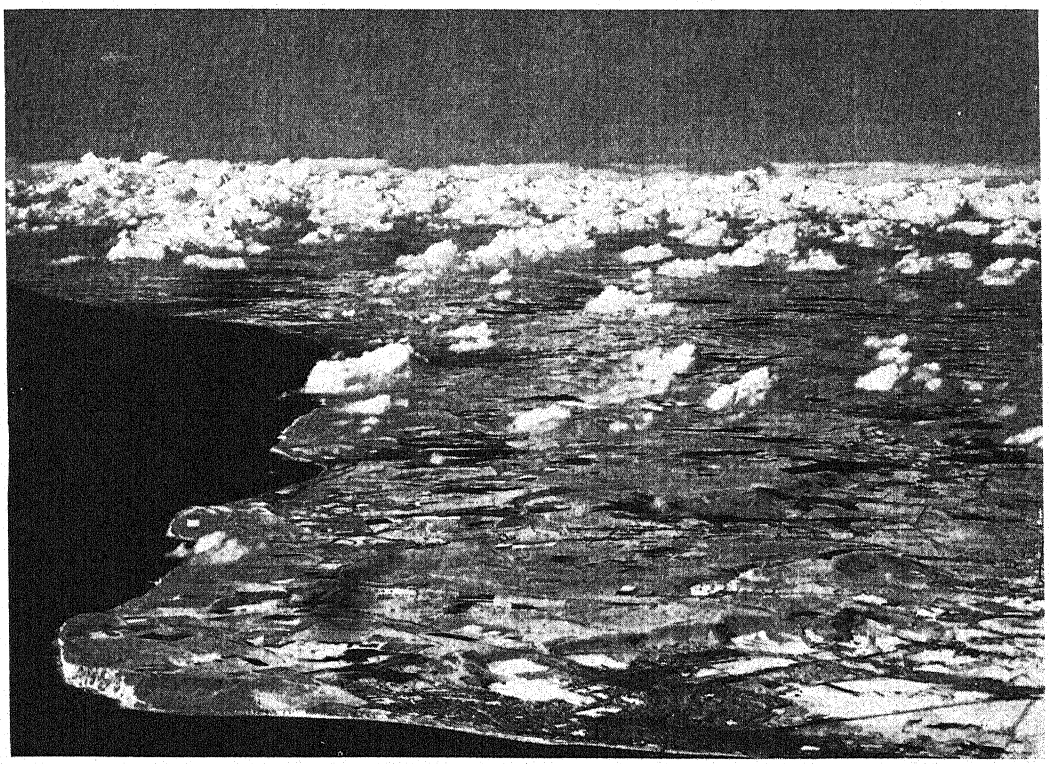
Ancient burial mounds, marked by a dark, circular band, sites of hill-top camps, Roman villas and sometimes complete villages have all been detected by the aerial camera.

In making photographs for this work much care has to be exercised in choosing the time when the exposures are made. Earthworks that are quite complete, for example, should be photographed either very early in the day or very late at a time when the sun is low. On the other hand, destroyed earthworks show up best in a strong light. The ideal conditions involve a clear atmosphere and a cloudless sky. The correct altitude varies, naturally, according to the size of the subject to be photographed; photographs of



TAKEN WITH A MINIATURE. What can be done with a miniature camera in securing pictures from the air is made evident by this striking photograph obtained with a Compass camera from the cabin of an air liner

Photo, Compass Cameras, Ltd.; 1/100 sec., f6.3, Ilford special Rapid panchro. plate, Wratten G filter



FAR AND WIDE. Only by using infra-red material can the photographer obtain such a vast panoramic view as this. The photograph shows the Sussex coastline from Eastbourne to Hampshire, the view extending to scores of miles. The height was 18,000 feet
Photo, "The Times"

large sites are generally made with the aircraft flying at about 5,000 feet, but in the case of small sites the height would be much less.

Wonders of Infra-Red. Probably the most spectacular advance in aerial photography has been in the production of long-distance pictures taken by means of infra-red emulsions. Atmospheric haze is always a source of trouble in air photography, especially in Great Britain. Even when the atmosphere is apparently perfectly clear, light is scattered by particles of dust or moisture, so causing obscuration, which is seen by the eye as a bluish haze. Penetration of this haze by the infra-red camera is due to the fact that the emulsion of the film or plate used is sensitive to red or infra-red rays, these being the least scattered of the radiations that fall on the haze. At the same time the superabundant light of other colours is absorbed by a filter which "blinds" the camera to ultra-violet, indigo, violet and blue.

In the earlier efforts at infra-red photography from the air the best results were obtained with "obliques," attempts at obtaining vertical photographs being less successful owing to the fact that the emulsion required a comparatively long exposure. Improvements in materials, however, have resulted in a greater sensitivity, so that infra-red photography from the air now offers a very wide scope.

In Great Britain some wonderful pictures have been obtained from aircraft flying at heights in the region of 17,000 feet. One such shows an immense vista covering the whole panorama of London and the coastline extending from Dover, lying 75 miles distant from the point where the photograph was taken, to Clacton-on-Sea. Another infra-red photograph, taken above Poole Harbour, shows the Isle of Wight, part of the South coast, and the Kent coast, the farthest point being some 120 miles distant (*see* p. 13).

Even more remarkable results have been secured by aerial photographers in the United States, where infra-red cameras have been used to photograph the landscape over distances of more than 200 miles. When the

stratosphere balloon "Explorer II" reached a height of 72,395 feet during an ascent in 1935, a vertical photograph was taken automatically by an infra-red camera. With astonishing clarity it shows the ground below over an area of about 105 square miles.

Amateur Air Photography

So far this article has dealt with the professional and scientific sides of air photography, and it may be that the amateur will have assumed that photographs from the air are beyond his sphere of activities. But this need not be the case. Given the right conditions, perfectly satisfactory results are possible when an ordinary camera is used to take pictures from aircraft. Assuming that the photographer is flying in an open-cockpit machine, he will have to observe certain rules. In the first place, if the camera is raised clear of the cockpit and windscreen, it must be grasped securely, for let it be remembered that there is a very powerful stream of air passing the aeroplane, even when it is in a gliding attitude, or flying at its minimum speed. It should also be kept in mind that the reflecting type of view-finder is useless in the air, and therefore a direct-vision finder should be employed. There is always a certain amount of vibration in an aeroplane, and this makes it essential that the shortest exposure possible be made, otherwise there will be a tendency to blur the photograph, and for the same reason the arms and hands should be held clear of the machine.

Photographs from Air-Liners

The most effective air picture is usually of the oblique type, and the impression of height and "flying" is accentuated by including in the view a small part of the aeroplane, such as a strut, bracing wire or the trailing edge or leading edge of the wing. But, of course, this should not overwhelm the rest of the picture.

For the air-liner passenger air photography is simple, for the spaciousness of the cabin gives him greater freedom of movement than does the cockpit of an open type light aeroplane. He is able to move about and, if necessary, stand up to secure his pictures, and the absence of draught facilitates the whole procedure in adjusting the camera for the work in hand.

For those amateurs who wish to take up air photography as a hobby there are cameras designed to suit their special requirements. An example is the Williamson "Pistol" camera. This instrument is constructed throughout of aluminium and weighs 3 lb. The body is built with a grip, and the shutter is operated by a finger trigger. This shutter is the louvre type, and is adjustable for speeds from "bulb" up to 1/200 second. The standard lens is a Ross Xpres of 5.3-inch focus with an aperture of $f4.5$, and a brilliant view-finder is fitted in a rigid tunnel on the top of the camera. The size of the pictures is $2\frac{1}{4} \times 3\frac{1}{4}$ in., and a special device on the back of the camera permits the use of either plates, film-packs or roll-film.

Using the "Pistol"

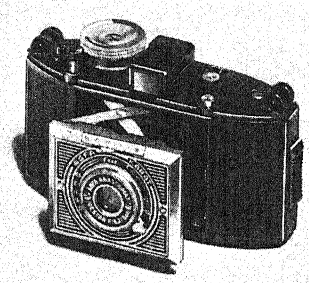
In using the "Pistol" the best method is to hold the camera with the right hand, resting it across the left arm, which is raised so as to bring the view-finder in line with the eye, with the back of the instrument some six inches away. A light filter can be used with advantage in conjunction with panchromatic films or plates. The best lens aperture to use will depend on light conditions and the speed of the plates or films, but when a filter is employed the full aperture ($f4.5$) is required. The shutter speed should never be less than 1/100 second, and can be increased to 1/200 second.

In taking photographs from the air the amateur must remember that there are regulations in force which debar the use of cameras over certain areas. Full details of these regulations are obtainable from the Air Ministry, Kingsway, London.

Photographs from the ground of aeroplanes in flight are not strictly "air photography," but we may perhaps discuss something of their technique. As a rule, of course, in obtaining a photograph of an aeroplane in flight, whether at the take-off or the approach for landing, the camera will be pointing skywards and a lens hood will be required, and an exposure meter is extremely desirable; under normal conditions, however, the exposure will be 1/200 second at $f11$. Fast panchromatic films or plates should be used, and a light filter will assist in rendering the machine visible against the light background of the sky.

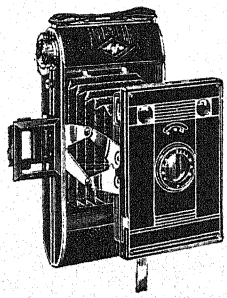
AGFA. Agfa cameras, photographic materials and accessories of German manufacture are handled in Great Britain by Agfa Photo, Ltd. Various types of camera are listed, and all are specially designed for amateur use with compactness and simple manipulation as salient features.

The Agfa "Speedex" series of cameras comprises seven types of the conventional roll-film, folding pattern. The smallest takes $1\frac{5}{8} \times 2\frac{1}{2}$ in. pictures, and has a substantial ribbed and plated metal body with black grained leather covering. The shutter is of the Compur type with 1 to 1/300 second, T. & B. The lens fitted is an Agfa "Solinar" anastigmat with an *f*3.9 maximum aperture. There are two view-finders, one being an optical direct-vision finder for taking photographs at eye-level, and the other is of the reversible brilliant type.



Agfa Karat

A more elaborate Speedex model is the "Compur," which is fitted with a number of devices to make it an efficient camera for more advanced work. The negative dimensions are $3\frac{1}{4} \times 2\frac{1}{4}$ in., and swing-out spool-holders are fitted. The film number indication window is provided with a spring-loaded shutter, to prevent fogging when high-speed Isopan films are used.



Speedex Clack

Two types of lens are available with this camera. One is of the three-component pattern and the other is a four-component assembly. The shutter is a Compur (speeds 1 to 1/250 second, and T. & B.), and delayed action is incorporated. View-finders consist of a reversible brilliant reflex finder, and one of the optical direct-vision pattern. Another type of Agfa "Compur" camera has a special ultra-high-speed shutter with speeds of 1 to 1/400 second, and T. & B.

Another series of Agfa cameras particularly suited for the beginner is known as the "Speedex Clack." These are fitted with two-component lenses and have built-in yellow filters, swing-out spoolholders and two view-finders. These cameras take roll-films which provide pictures measuring $3\frac{1}{4} \times 2\frac{1}{4}$ in. A fourth Agfa model is of the simple box type. This has a meniscus lens and takes $2\frac{1}{2} \times 5\frac{1}{8}$ in. films.

Among the latest introductions of Agfa Photo, Ltd., is a miniature camera, taking 12 pictures on standard 35-mm. film. This camera, the "Karat," equipped with an Igestar lens of 2-inch focal length, working at *f*6.3, is a good example of a comparatively low-priced miniature camera. An automatic lock on the film-winder prevents double exposures or accidental release of the shutter. An Automat shutter gives speeds of 1/25, 1/50 and 1/100 second as well as T. & B., and an automatic picture counter is provided.

The Agfa "Movex" is a cinematograph camera specially designed for the amateur. It carries 100 feet of 16-mm. film.

The well-known Agfa films are manufactured in flat and in roll form, and as packs. A list of this material is given below.

ROLL-FILMS

Initial & Number	Size (inches)	Exposures	To Fit Camera as Under.
A 27	$1\frac{5}{8} \times 2\frac{1}{2}$	8	Speedex Box 41, V.P.K.
B1 17	$2\frac{1}{4} \times 2\frac{1}{4}$	6	Brownie 1
B2 20	$3\frac{1}{4} \times 2\frac{1}{4}$	8	Speedex Compur, Clack, Record, Brownie 2.
PB 20	$3\frac{1}{4} \times 2\frac{1}{4}$	8	Kodak 620
D 16	$4\frac{1}{4} \times 2\frac{1}{2}$	8	Brownie 1a, 2a
PD 16	$4\frac{1}{4} \times 2\frac{1}{2}$	8	Kodak 616
E 18	$4\frac{1}{4} \times 3\frac{1}{4}$	6	F.P.K. 3
G 22	$5\frac{1}{2} \times 3\frac{1}{4}$	6	F.P.K. 3a
M 30	$4\frac{7}{8} \times 2\frac{7}{8}$	6	Brownie 2C
N 29	3 × 2	6	Ensignette 2

FILM-PACKS

Initial & Number	Size	Exposures
F 00	$2\frac{3}{8} \times 1\frac{3}{4}$ ins.	12
F 20	$3\frac{1}{4} \times 2\frac{1}{4}$ "	"
F 40	$4\frac{1}{4} \times 1\frac{3}{4}$ "	"
F 31	$2\frac{3}{8} \times 5\frac{1}{8}$ "	"
F 18	$4\frac{1}{4} \times 3\frac{1}{4}$ "	"
F 22	$5\frac{1}{2} \times 3\frac{1}{4}$ "	"
F 26	$6\frac{1}{2} \times 4\frac{3}{4}$ "	"
F 15	7 × 5 "	"
F 41	9 × 12 cms.	"
F 43	12 × 18 "	"

The following 35-mm. films for miniature cameras are available in lengths sufficient for 36 exposures and also in rolls of 15, 50 and 80 feet: Orthochromatic-Isochrom FF and Isochrom F; Panchromatic-Isopan FF, Isopan F and Isopan ISS. Agfa flat films are manufactured in all standard sizes.

A special Agfa film now available is the duplicate film which provides in one operation a negative from a negative or a positive from a positive.

The new Agfa daylight developing tank, the Rondinax 60, is worthy of mention. It is made for roll-films $2\frac{1}{4} \times 3\frac{1}{4}$ or $2\frac{1}{4} \times 2\frac{1}{4}$, and only 4–5 oz. of developer are needed for a complete charge. With this tank even panchromatic film can be developed and fixed without need of a dark-room. The tank separates the film from its backing paper and rolls it on to a spool with spiral grooves.

Much work has been done by this concern in regard to colour photography (*q.v.*) and a new Agfacolor film process is now marketed.

A special feature of this system is the freedom from grain of the image. There is no silver in the processed film, as the deposit of silver covering the dye images is finally removed by a mild oxidizing solution, while the dye image itself is practically grainless. The Agfacolor process can be used with normal apparatus and no special filters or lenses are required. (For fuller details *see* Colour Photography.)

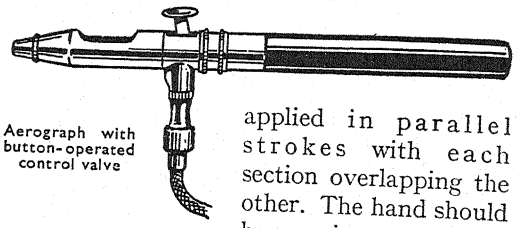
AIR-BRUSH. An air-brush is a device used for retouching photographs, and consists of a pencil-like instrument which is connected to a compressed-air chamber or pump by a flexible tube. A typical air-brush is the Aerograph.

In this instrument the compressed air passes through a button-operated control valve into the body of the brush, and in escaping through a nozzle draws liquid (usually water-colour) from a small reservoir and ejects it in the form of spray.

The air-brush is used very extensively in commercial photography for retouching photographs and enlargements. By its application unnecessary details can be filled in, backgrounds obliterated, high lights can be intensified and shadows strengthened.

Retouching with an air-brush requires considerable skill, and it is advisable for the amateur to practise before attempting to treat any serious work with it. The device is held in a similar manner to a pen, and a downward pressure of the forefinger on the button will set it in action, the amount of colour ejected being increased by drawing the button backwards and vice versa.

In producing graduated tints the stroke made with the brush should follow the direction of the contours under treatment, and in making flat tints the colour must be



Aerograph with button-operated control valve

applied in parallel strokes with each section overlapping the other. The hand should be moving when the finger-button is pressed, and the movement should be continued after the flow of the liquid has stopped, or otherwise too much colour will be applied at the end of the line that has been traced.

To ensure proper atomization and to avoid coarseness of texture the air pressure, usually of between 20 and 40 lb. per sq. in., should be maintained as uniform as possible. *See* Retouching.

ALBUM. A photographic album is a book, usually of plain leaves, specially designed for the collection and storage of photographic prints and negatives.

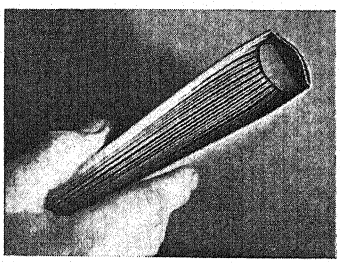
The day of the cumbersome leather-bound, gilt-clasped and gilt-edged "family album" is past. The photographic album of today is made with a view to pictorial rather than genealogical interest.

Print albums are obtainable in three forms: namely, the "slip-in," the bound album resembling a scrap-book, and the loose-leaf album. The slip-in album accommodates a specified number of prints of one size behind cut-out openings in the leaves. It does not permit of any variation in the arrangement of prints upon a page, nor in the proportions of an individual print. In consequence of these limitations, the slip-in album is not greatly favoured by practical photographers.

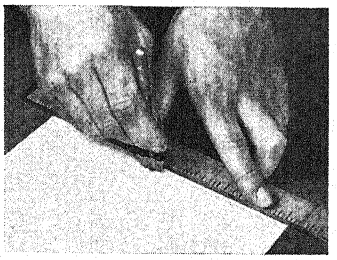
In fact, it is seldom advisable to mount more than a single picture on each page of an album, on account of the inevitable competing interests which must ensue.

The bound album, besides being composed of a fixed number of pages, often has comparatively thin leaves. If photographs are pasted upon such thin paper, the latter is apt to buckle severely. Although dry-mounting in bound albums is possible, it calls for considerable skill and ingenuity.

A good way to mount photographs in a bound album is by means of gummed paper hinges, in similar fashion to that employed by stamp collectors, but with stronger hinges. Another suitable method is to apply very small spots of fish-glue adhesive near the corners at the back of each print. Although the acid content of such adhesives is reputed to affect the silver image of photographs, the writer has found no ill effects from employing this method even on the more delicate images of prints on daylight "self-toning" paper made and so mounted 25 years ago. Thick rubber solution is a useful mountant by which prints may be tacked into albums with satisfactory firmness. It has the advantage that prints can be removed at any subsequent time, when all traces of the adhesive will disappear on rolling it off with a dry finger-tip.



A photograph album should have ample binding-space to allow for subsequent expansion



Home-cut album leaves can be neatly scored, for folding without cracking, with a blunt glass-cutter

Never mount the print dead centre on the page; a much better effect is obtained by placing the picture nearer the top than the bottom and slightly nearer the inside.

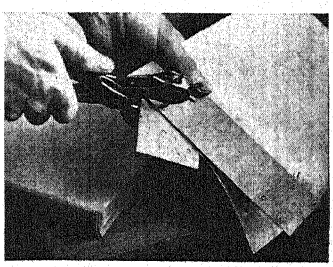
When one's interests are fairly wide, it is a good idea to mount prints in a series of albums according to subject: architecture, birds, children, etc., or even wider classifications like "The Charm of Kent," "Holiday Tours," etc. Title every print and, if possible, add, as unobtrusively as possible, details of film, stop and exposure.

The loose-leaf album is advantageous, because the leaves are stiffer and, being removable, are more amenable to convenient mounting of prints upon them by any usual method. It also permits of removal or replacement of a leaf at any time, or complete rearrangement of the contents at will. Whatever form of album is selected, it should be noted that photographs are thicker than most other things that are collected in albums, and the binding should allow for the inevitable and considerable expansion of the leaves. A collection of large prints, dry-mounted in pairs back-to-back, and trimmed to size after mounting, will form a very handsome volume if creased and punched loose-leaf fashion.

Albums for film negatives, their leaves composed of tissue envelopes, are familiar details of commercial supply. *See* Filing Systems for Negatives.

ALDIS. Aldis photographic lenses are of British manufacture, and are incorporated in a large number of cameras marketed today.

The firm of Aldis Brothers, Ltd., produces lenses for folding hand cameras, reflex cameras, and studio and enlarging apparatus; and it is also responsible for the Aldis epidiascope.



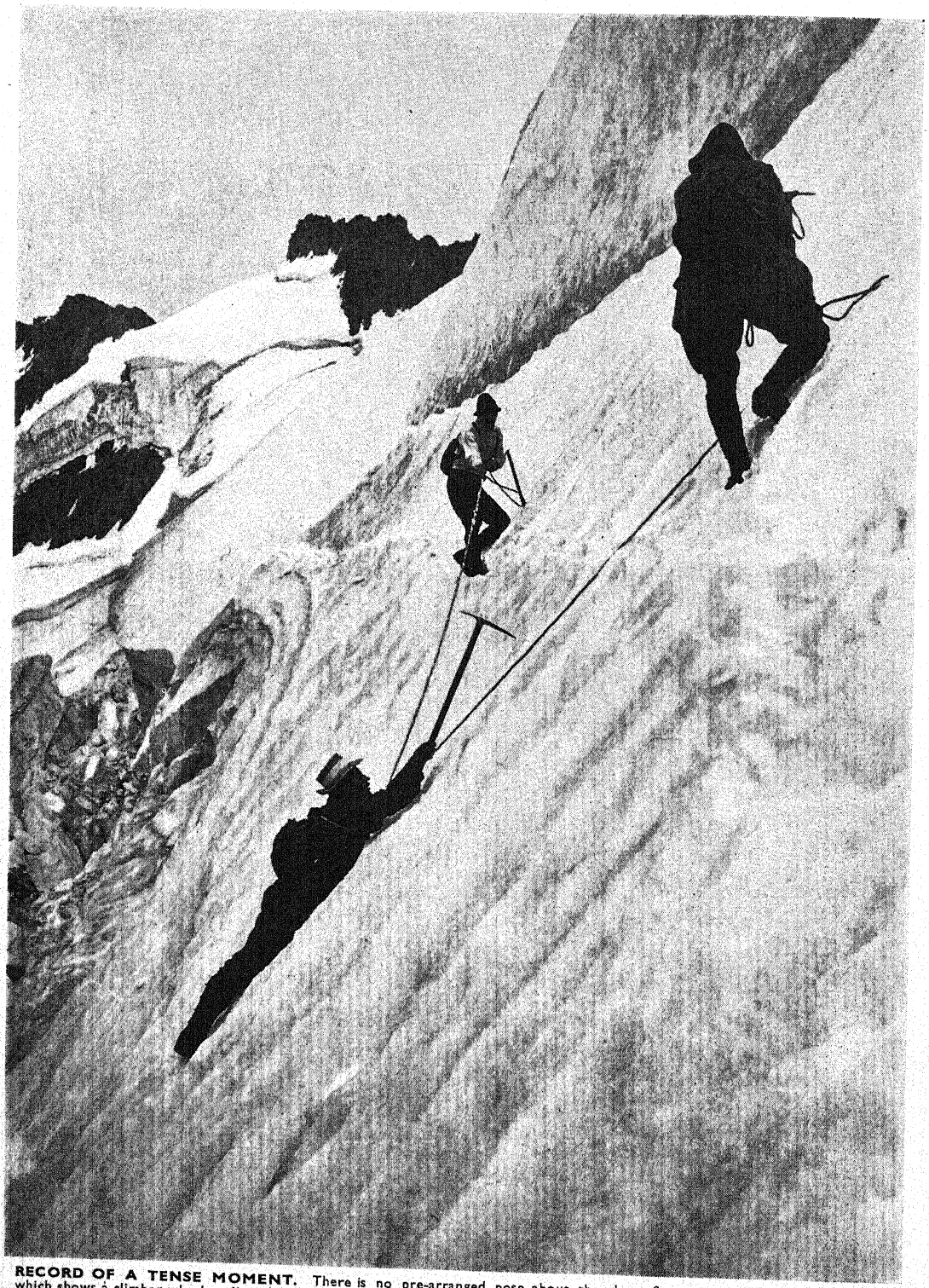
Accurate punching of filing holes is best done like this, with a cardboard template

The lenses known as the Series II A *f*6·3 are specially designed for hand cameras. They are of short overall length, so that compactness is achieved; and in their design particular attention has been given to covering power.

Other Aldis lenses of note are the *f*6 and *f*7.7, which are of the astigmat type.

This company also manufactures lenses for photomicrography, the *f*6·5 photomicro lenses being outstanding examples.

The Aldis epidiascope is an ingenious apparatus for making screen projections. It provides pictures up to 9 ft. 7 in. square or circular pictures of 13 ft. 10 in. diameter.



RECORD OF A TENSE MOMENT. There is no pre-arranged pose about the three figures in this Alpine photograph which shows a climber who has slipped on the ice slope and is in imminent danger. The picture was taken at 11,000 feet in the Dauphiné Alps

Photo, Donald McLeish; f11. 1/25 sec., Monarch plate

ALPINE PHOTOGRAPHY ABOVE THE SNOWLINE

Donald McLeish

Great opportunities are open to the photographer who travels to Alpine heights, where rocks, snow, crevasses, sky and panorama come within range of eye and camera lens. In this article an expert of world-wide fame in Alpine photography provides most valuable information for those who contemplate this branch of the art

See also Mountaineering

For photographic work above the snowline the simpler the apparatus the better. The strength that naturally follows on simple construction is a chief factor towards success. Many modern cameras are a mass of complications, loaded with more movements than could be found use for in a lifetime. Such gadgets look very pretty in the dealer's window, but are thoroughly useless in the Alps, and merely afford additional opportunities for error.

The details of lighting, composition, exposure, etc., added to the labour of an ascent, with perhaps a dash of mountain sickness thrown in, are quite enough to occupy an ordinary individual.

For the rough-and-tumble of mountaineering nothing is so suitable as the box-form camera. This type is again in fashion, at least in the smaller sizes. It has the great advantage that the lens front always remains parallel with the plate or film. Next to it comes the folding variety favoured by press photographers, where the front is held rigidly extended by four struts. In both types the lens is fitted in a focussing jacket engraved with figures that indicate distances in yards or feet. This is the ideal method of focussing and the least likely to get out of order.

A Box-Form Camera Best

The camera that has accompanied me in many Alpine seasons is a simple box form of my own make, having the lens deeply recessed, fitted with large brilliant viewfinders and carrying 5 × 4 in. plates in dark slides.

On one occasion it escaped me and fell some three hundred feet down the Matterhorn. It was afterwards discovered in a heap of rock débris. The back had been wrenched off, and the wooden lens hood smashed but the lens itself was undamaged and, still more wonderful, not a plate was broken. The camera had resisted like a solid block, and in a few minutes was in use again.

It would be easy to imagine the condition of a reflex camera with its delicately poised mirror after such treatment, or one of the usual bellows type, with its lightly stayed, unprotected lens front.

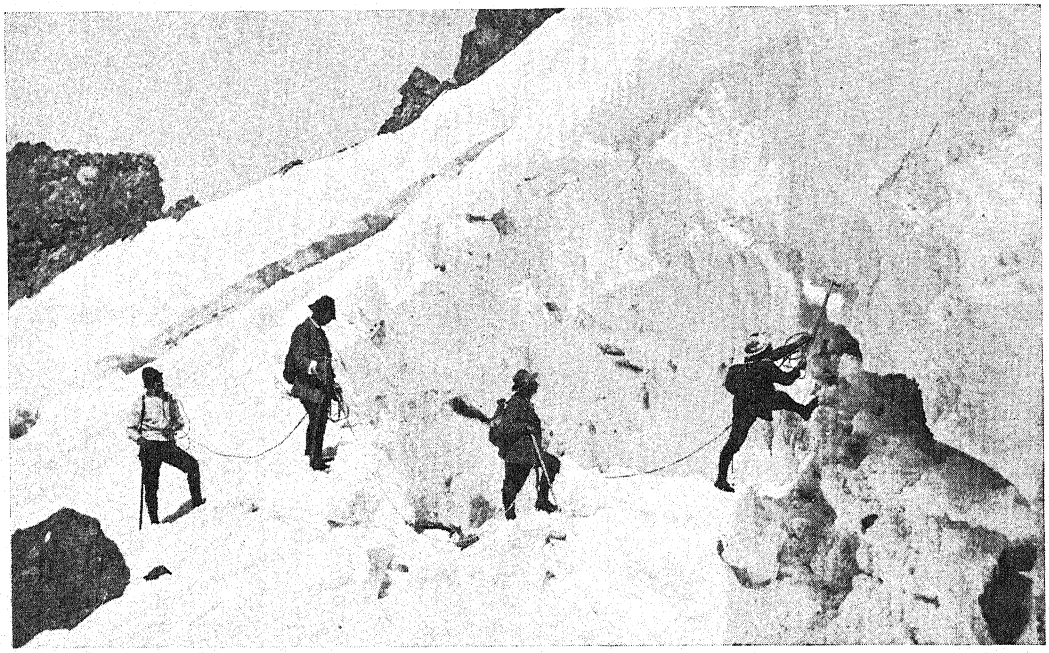
The only movement that the Alpine worker may find useful is the rising front ; but even this can be omitted if negatives are intended for enlargement. Distortion due to tilting the camera upwards can always be rectified.

Aperture and Focal Length

An anastigmat with an aperture of *f*6.3 will cover all needs for snow, ice and rock subjects where stopping down is the rule, but a faster lens is useful for pictures in the comparatively dark forest region. The fewer separate glasses in the lens the better ; a cemented doublet is thus preferable. A lens with four reflecting surfaces will yield a brighter image than one with six, and much brighter than one with eight.

The focal length should be at least equal to the diagonal of the plate or film; a longer focus is sometimes advisable. But with the small-size cameras that are now fashionable, subsequent enlargement is almost essential to produce satisfactory pictures. In so doing it is always possible to enlarge only the most attractive section of a negative. This will give exactly the same result as if a longer focus lens was used in the first place. The recent introduction of fine grain emulsions and developers is a great help in this direction. They allow of enormous enlargement of negatives, and the making of pictures scarcely to be distinguished from contact prints.

Alpine landscapes differ from all others in the sense that more light comes from



GRADATION AND DELICATE TONES. In this photograph of mountaineers cutting a way up a glacier, the sunlight and shadows falling on the billowed snow and ice have been finely recorded. As explained in the text, a lens hood is necessary when taking photographs of this kind owing to the light radiations from the snow, ice and sky.
Photo, Donald McLeish

sunlit snow and ice than from the sky itself. The neglect to shield the lens from this intense radiation is largely responsible for the general poor quality of mountain pictures. A lens hood is therefore essential. It should be generous in length, with a rectangular opening of such shape and size as to cut off all light except that which the lens actually requires to cover the plate or film. Modern lenses throw a wide area of illumination, and masses of superfluous light scattered about a camera interior will inevitably produce fog in shadows and half tones. This consideration would appear obvious, but I have often seen workers attempt difficult snow subjects with a lens wholly unprotected.

A roller-blind shutter is more efficient than one of the between-lens type, but the advantage is negligible in Alpine work. All shutters, however, are apt to behave erratically in extreme cold and should be tested before each exposure.

On one occasion, when I was on the summit of the Col d'Herens at sunrise in a temperature far below freezing, my shutter struck work altogether until set at a 1/100 and then moved sluggishly across the lens.

A tripod is not a necessity in Alpine photography. It is apt to prove an awkward companion to a climber when spreadeagled on a rock face, and might start a fall.

On occasion the camera can be rested on the head of the ice axe ; this is a great aid to steadiness. But above the snow line the photographer is served with a superabundance of light. Even when employing colour filters that reduce the light four times, exposures are still in fractions of a second.

But here a word of warning is necessary. The climber, after any movement, should allow a few minutes to elapse before making an exposure. He may be sound enough in wind and limb, but after strenuous exertion in rarefied air he cannot prevent his heart from beating many times above normal. These vibrations will inevitably be registered in the picture. It is this and not the absence of a tripod that accounts for so many blurred mountain photographs. In the Alps, as elsewhere, " haste is of the devil."

Unless the worker indulges in after-treatment of his negatives, he will probably prefer roll-films to plates. In addition to lightness, they have the great advantage of abolishing

the misery of plate changing, which is at its worst in an Alpine hut after a strenuous day when the next climb has to be started at two o'clock in the morning. The tyranny of the red lamp is not to be expressed in words usually found in the dictionary.

The beauty of Alpine landscapes is almost entirely dependent on form, the delicate shadows and half-tones on curving snow fields, and the stronger details of crevasses. Owing to the nearly total absence of colour there is little to be gained by the use of colour filters and orthochromatic emulsions except, perhaps, to give a deeper tinge to the sky But at ten thousand feet and upwards the light has far less actinic value than at sea level. In the taking of hundreds of mountain subjects I have seldom found difficulty in getting full distinction between snow and sky on ordinary plates.

When to Use Filters

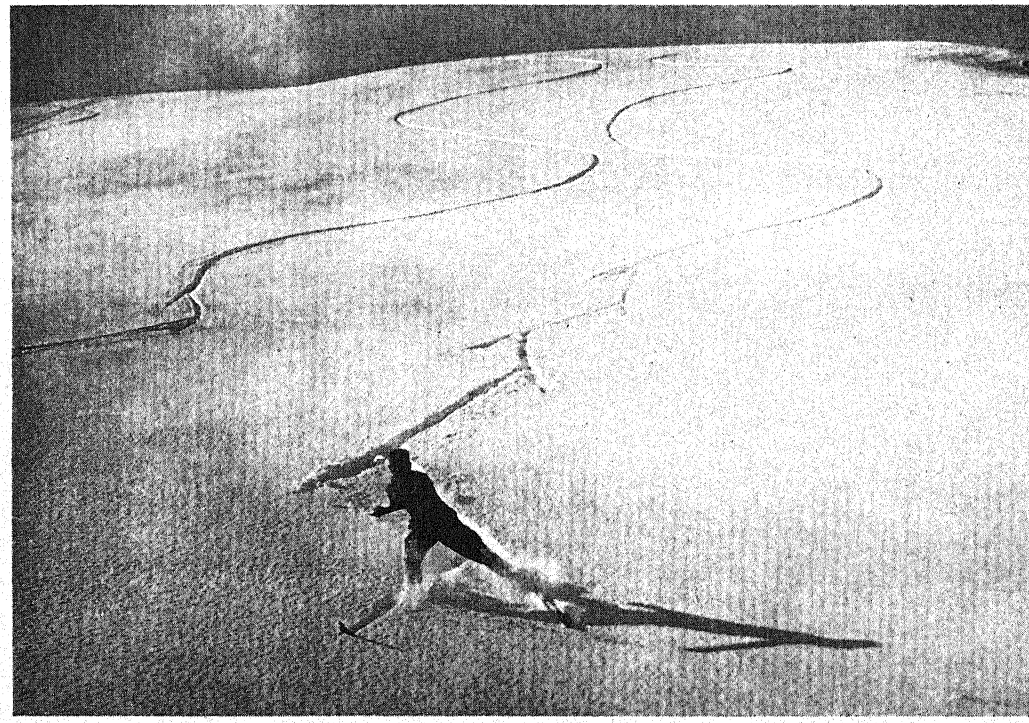
There are occasions during bad weather when the sky is paler than usual; at such times a filter that increases exposure about twice is advisable. But unless used with judgement filters result in over-correction of the sky, giving it a thunderous blackness that suggests anything but light and sunshine. They are also apt to cut out delicate atmosphere, making a mountain fifty miles away look as distinct as one near at hand.

Some of the most striking pictures are of subjects taken at close quarters—the fantastic towers and pinnacles of ice falls, and the impressive depths of crevasses.

The luminous shadows of these ice masses partake more of green than blue and thus are rendered with greater contrast on ordinary emulsions. On the whole the balance of advantage is with the non-ortho variety used without a filter.

In the valleys where forest and vegetation are included. conditions are totally different. Here the use of emulsions sensitive to green and yellow, with filters that increase exposure up to four times, is essential, in order that the negative should have sufficient density in foliage detail to print along with distant high lights.

An important element in success is the use of thickly coated plates or films. In



CURVES IN THE SNOWFIELD. In Alpine photography the tonal relationship of snow and sky is of great importance. When filters are used they must be chosen with care to avoid over-correction of the sky. It might be argued that slight over-correction has occurred in this excellent picture, but without it the snowfield would lose much of its brilliance

Photo, Ilford, Ltd., on Selo film

the photography of ice and snow there is a constant tendency to flatness. The intense radiation literally burns its way through a thin emulsion, and reduces lights and shadows to a uniform level. Manufacturers now supply these special coatings. Great errors in exposure can be rectified with the extra density thus obtainable, and subsequent reduction of negatives with ferrocyanide or persulphite will give further means of control. Plates, if used, should, of course, be backed for Alpine work.

The wide variations of Alpine subjects make it difficult to give definite times of exposure. A panoramic view from a mountain top naturally requires less than a study of crevasses and ice falls, and still less than a picture of rock formations. For sunlit snowscapes 1/25 second at *f*16 on a plate of 400 H. & D. should be about right. Towards sunset and just after sunrise I keep the same shutter speed, but increase the lens aperture to *f*8.

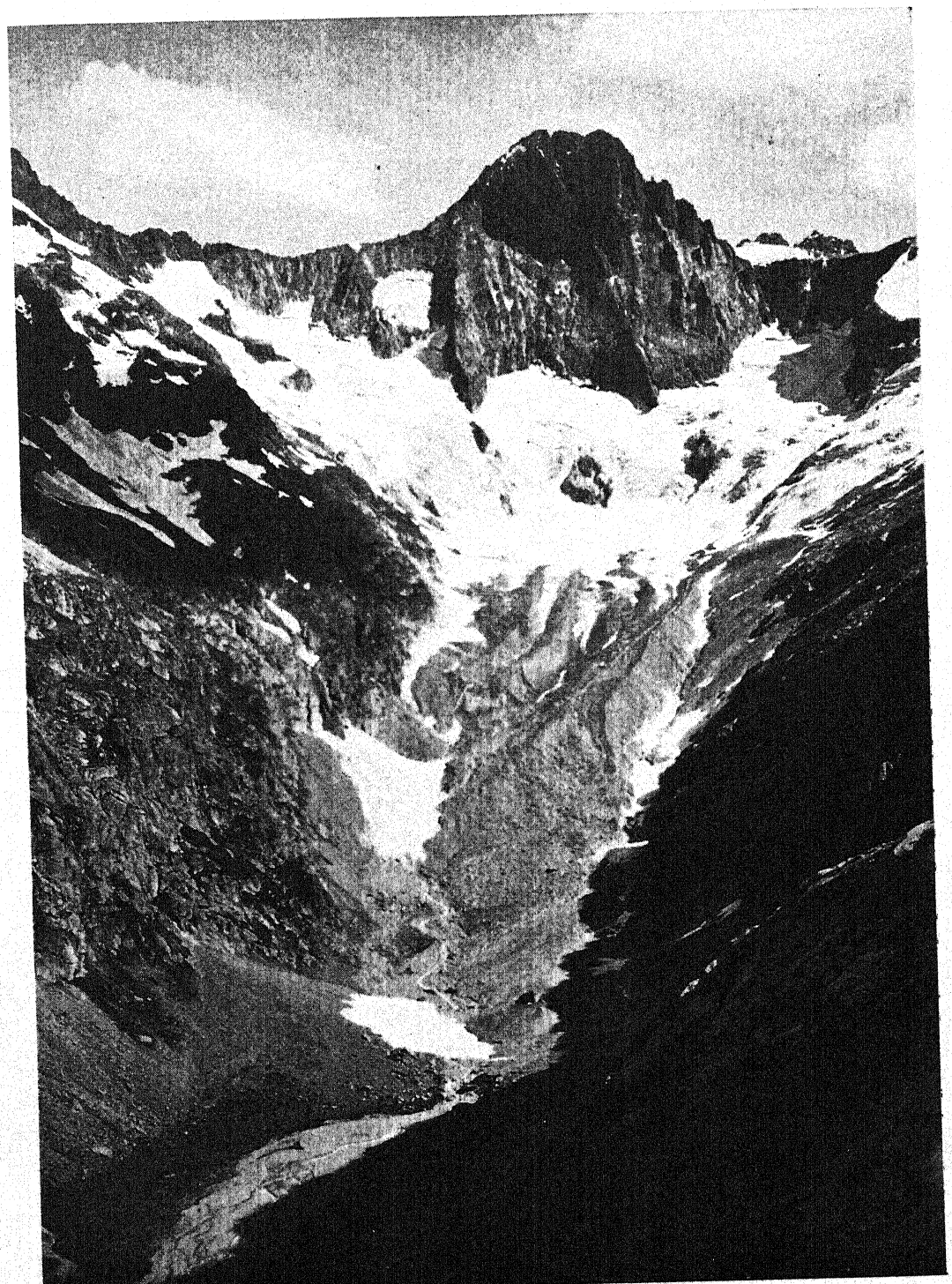
An actinometer of the darkening paper type is useful in judging light values, but exposure is governed by the character of a subject also, and here the actinometer gives no help. The maxim " Expose for the shadows and allow the high lights to look after themselves " does not work above the snow line ; the high lights only must be considered for details in snow and glacier.

For the serious worker the best plan is to start by making a few duplicate exposures, and to develop them in the seclusion of his hotel bedroom. He will probably discover other unexpected errors besides that of faulty exposure, and the information derived will enable him to carry on with confidence for the rest of his trip.

The method of carrying the camera is important. In my own practice a 5 × 4 in. camera with plates sufficient for a three days' traverse before descending to the valley makes a bulky package, although it is easily carried in the rucksack. But whatever the size of camera, it is best in the rucksack, where it is far less likely to be damaged than if it is precariously carried in the pocket. I have left the subjects of lighting and



PEAK PANORAMA. Jotunheim seen from the Galdhopiggen, Norway. At a high altitude, such as that at which this photograph was taken, there is frequently an abundance of ultra-violet rays, and exposures must therefore be accurately calculated
Photo, J. E. Archbald, A.R.P.S. ; f22, 1/25 sec., Selo hypersensitive pan. roll-film



TOWERING PEAK AND SHADOWED VALLEY. In this impressive photograph of Les Ecrins (Dauphiné) the progressive blending of tones, ranging from the deep shadows of the rock formation to the sunlit snow, has been perfectly reproduced. Such gradation is largely due to careful consideration of high-lights

Photo, Olaf Bloch, Hon.F.R.P.S.; f8, 1/50 sec., Selochrome film pack



PASS AND DISTANT RANGE. The human figures seen in this picture, taken at the summit of Fee Pass, are important in giving relief to the plain and featureless foreground. They also emphasize the grandeur of the distant peaks, which appear with a notable absence of haze, due to the high altitude

Photo, Donald McLeish ; Ilford Monarch plate, 1/25 sec., f16

composition to the last. In reality these have greater influence on technical and pictorial quality than has the nature of apparatus. A worker with artistic perception will create a series of striking pictures with the most primitive camera, whereas another who relies entirely on an expensive outfit, and blazes away at whatever comes before his lens, will bring home little but dingy distortions not worth examination.

In Alpine photography the mid-day hours are the least satisfactory. The vertical sun reduces snow and glacier undulations to a uniform flatness. Some of the finest effects are obtained near sunset when every prominence and peak is thrown into relief, when the curving snowfields show infinite gradations of light and shade and all the beauty of shadows within shadows, and the slanting sun gives full impressiveness to the depths of crevasses. At sunrise also the valleys below are often filled with a sea of clouds from which the snow-crowned mountains rise with extraordinary clearness.

Such effects are naturally reserved for the expert mountaineer who makes use of Alpine huts during the traverse of peaks and passes. He is likely to secure a much finer series of pictures than a man who finds it necessary to descend to his hotel every night.

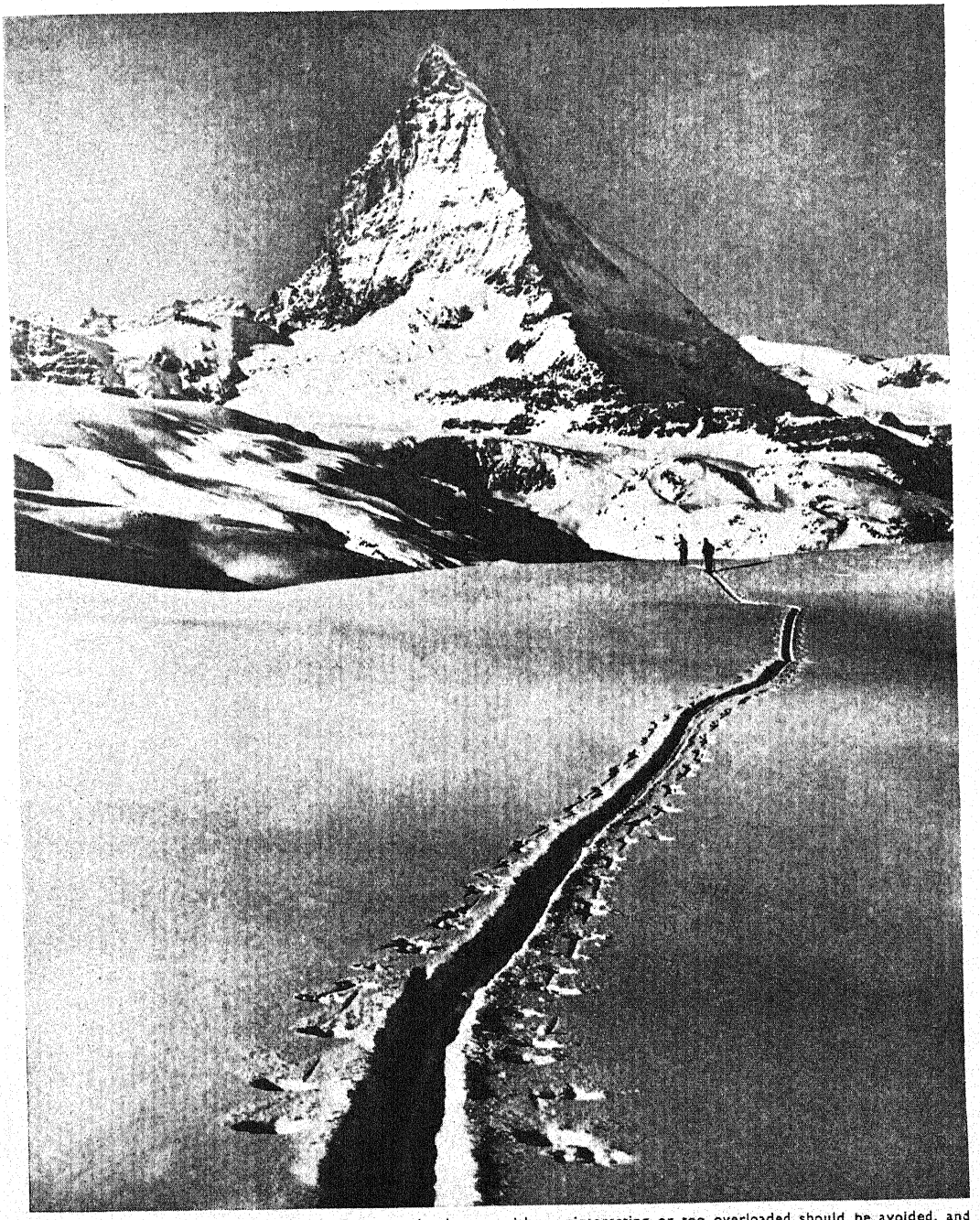
It is rarely advisable to photograph a subject with the sun full on it ; a cross lighting is better. Beautiful effects are often secured by pointing almost into the sun, and this is where a generous lens hood is most useful. Exposure in these circumstances should be at least doubled. The photographer need not fear trouble from atmospheric haze ; it is almost non-existent at high altitudes.

An Alpine view like any other should have one leading feature to which all others are subordinate, and this feature should never be exactly in the middle. A curving glacier in the foreground, or even a single crevasse, can often be made to lead up to and emphasize the beauty of a distant peak by a careful choice of position. A foreground of some sort is essential, it adds fifty per cent. to the value of a picture. It may consist of isolated rocks, or merely the shadows of drifted snow, but large areas of dark rock are best avoided. A mountain at one side of a view needs to be balanced by opposing lines at the other. But it must be a balance of mass—not of shape. Nothing is worse than the presence of features of equal importance in the same picture.

Value of Figures

The use of appropriate figures adds much to the attraction of landscape subjects. In Alpine pictures figures are essential if only to give scale. People who have not visited the Alps are apt to be bored by a series of mountain views. This is due not only to the absence of life but to the impossibility of judging the size of mountain masses. Alpine photographs without figures give no clue as to whether any particular peak is three hundred or thirteen thousand feet high. I have seen an apparently perfect photograph of the Jungfrau produced from a plaster model on a table top.

One's climbing friends can be utilized to give scale. They should be taken at some definite Alpine occupation, crevasse traversing, step cutting, etc. Judgement is required, and also tact, or the photographer will



BENEATH THE MATTERHORN. Foregrounds that are either uninteresting or too overloaded should be avoided, and there should be one main object in the composition to which everything else should be subsidiary. In this striking photograph of the Matterhorn the skier's track is an effective part of the composition

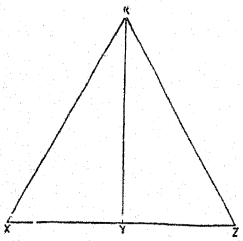
Photo, Ilford, Ltd

become unpopular. Bribery is often necessary, and a secret arrangement with the guide is of immense service.

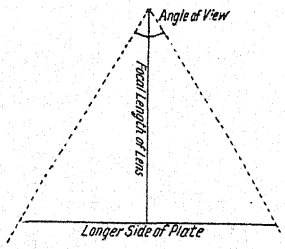
Figures should invariably be below the photographer's level so as to give value to the distance and upward sweep of the mountain beyond, and should seldom be less than a hundred feet away. It is the grandeur of the Alps rather than the importance of man that is to be emphasized.

ANGLE OF VIEW. Optically speaking, the angle of view of a lens is the amount or extent of a view or image which the lens throws upon the focussing screen or plate of the camera.

When a pinhole is used in place of a lens the angle of view may be said to be infinite, for it depends only upon the size of the plate and its distance from the pinhole. All lenses, however, have strictly limited angles of view, which, for ordinary working purposes, may be measured approximately by the following simple method:



Take a sheet of paper and draw upon it a horizontal line, XZ (top diagram), equal in length to the longer side of the plate or film used. Bisect this line at Y and from Y draw a vertical line, YK, equal in length to the focal length of the lens employed. Then, by means of a protractor, measure the angle XKZ at the apex of the triangle thus drawn. This will represent the angle of view of the lens when employed in conjunction with the plate or film whose longer side is equal in length to the horizontal line XZ.



Lenses may be arbitrarily divided into narrow, medium and wide-angle types. This classification, however, must only be regarded as a rough and convenient one, for, in many respects, the view angle of a lens depends upon the size of plate with which it is used. Thus a medium-angle lens used with a small plate would give a narrow angle of view, while employed with a larger-sized plate or film its view angle would be greater. For a given size of plate, however, the greater the focal length of the lens the smaller its view angle becomes, and, within limits, the smaller the focal length of the lens the wider is its angle of view. Lenses constructed to give very extensive view angles are known as " wide-angle " lenses.

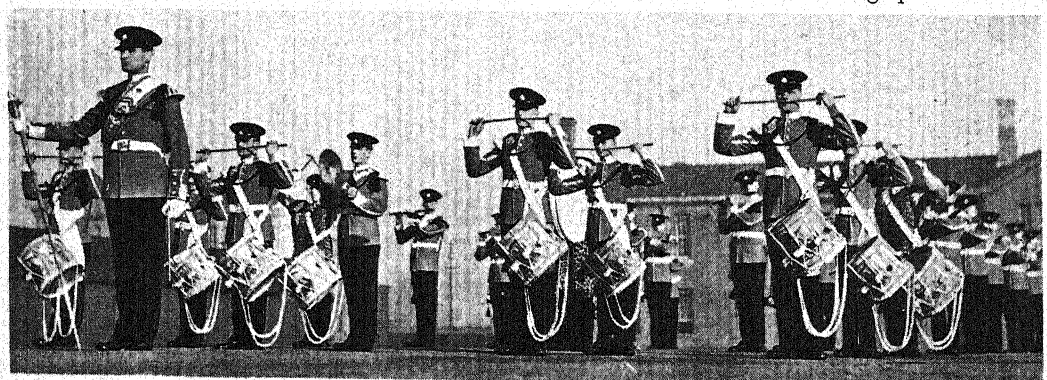
ANGLE SHOTS FROM UNFAMILIAR VIEWPOINTS

The angle shot is now extensively employed in order to give emphasis and dramatic force; but, as explained here, mere striving after " effect " gives meaningless pictures

For so many years people have been accustomed to looking at photographs taken to conform to certain conventional conditions, that when an attempt is made to represent a subject from an unusual point of view the result is often condemned as untrue.

In recent years the tendency to perceive familiar objects from unfamiliar viewpoints has been fostered by the cinema. The amateur, in other words, has been taught that there are many other recognizable views of a subject than those taken on the level.

It is true that to point the camera upwards at a vertical building produces an



THE 'LOW-DOWN' ON THE DRUMMERS. The above photograph is an excellent example of how the dramatic effect of a composition can be enhanced by the choice of an unusual viewpoint. A marked gradation of height occurs between the leading and rear files, while the leaders, instead of being vaguely defined against a barracks in the background, stand out against the sky

Photo, Bernard Alfieri, Jr.

effect which at first seems all wrong, although a little thought will demonstrate that vertical perspective is just as accurate as that which is accepted in horizontal perspective.

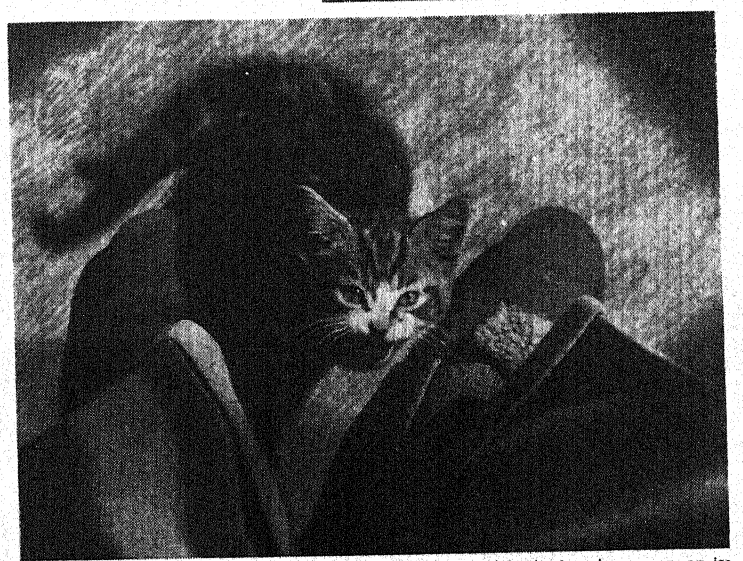
The same applies when the camera is pointed downwards from a height, but in this case there is always a much greater opportunity of obtaining more attractive subject matter than is available when pointing the camera upwards. In the latter instance the subjects are limited largely to architecture, trees and sky, but looking downwards one has not only architecture but every type of foreground material, including water, and also people, animals and other moving objects which may occupy the ground at the time of exposure.

Without venturing into the realm of "stunt" photography it is possible to get very attractive pictorial results by taking photographs of subjects seen from a height. Even a short flight of steps will suffice for securing a looking-down effect. The subjects which will be most pleasing are those on which we look down naturally. Striving after effect by photographing objects from a totally unusual position will result



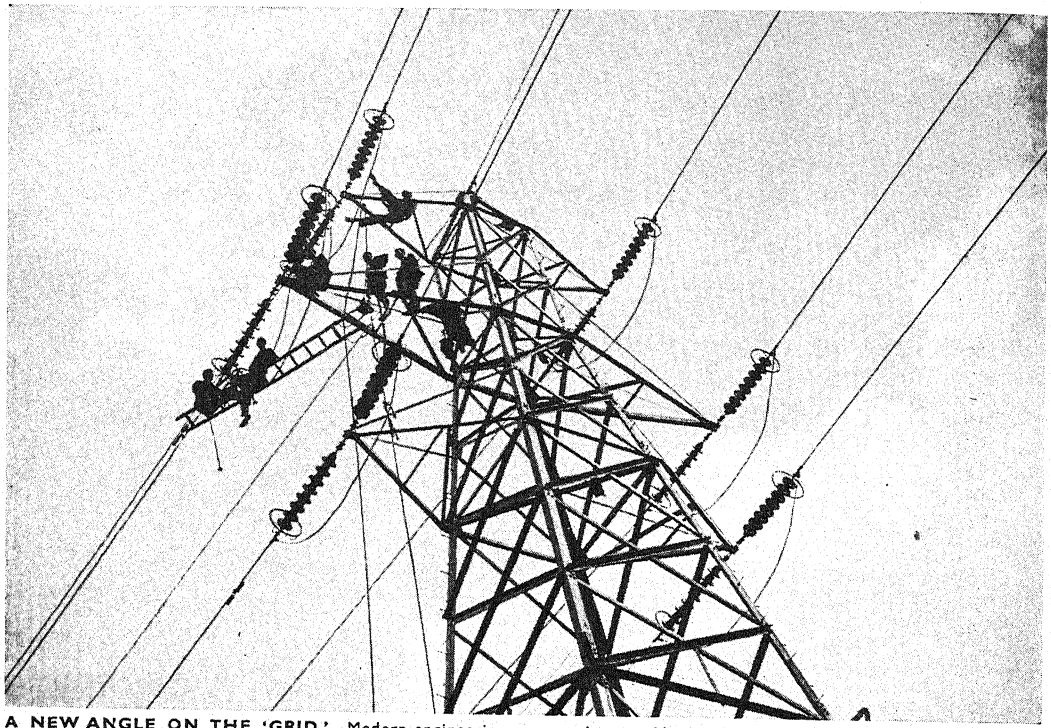
CITY GOSSIP. It is well-nigh impossible to make an interesting composition of a cluster of people from the ordinary viewpoint, since only the backs of those nearest the camera can be seen. The above is a clever solution of the problem

Photo, John H. Ahern, F.R.P.S.



PLEASE! Here an amusing photograph has been secured by having the camera on its tripod pointing vertically to a sun patch on the floor. The operator sat with the shutter release in one hand and a milk "bait" in the other

Photo, Cecil D. Notley: Rolleiflex camera, on Isochrom film



A NEW ANGLE ON THE 'GRID.' Modern engineering construction provides ample scope for angle photography. In this photograph of an electric pylon the angle has been well chosen so that the picture forms a pleasing composition based on triangles. It also has the advantage of avoiding a gross distortion of verticals that might otherwise be unavoidable

Fox Photos

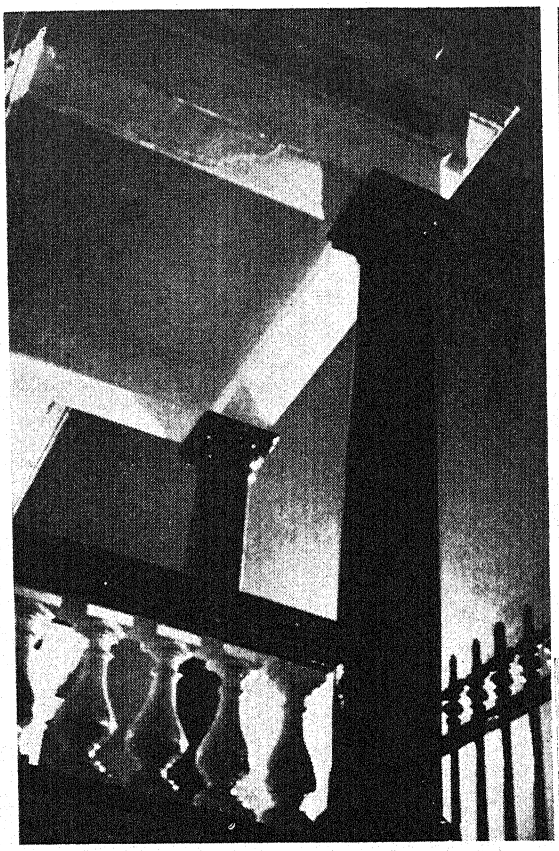
probably in the photographs being merely freakish. Any gathering of people must be photographed from above if the whole scene is to be recorded. Open-air cafés and market scenes are most effective photographed in this way. The higher the viewpoint the more the details will tend to be lost, but detail is not the aim in such subjects; it is the general effect which must be studied.

The most ordinary subjects will have interest added to them if photographed from above. Take any ordinary street and make a series of photographs taken from an upstairs window, and you will probably be surprised at the variety in the results. Water is a particularly fascinating subject to look down upon. A pier or quay will provide plenty of suitable material. Boats moored to the quay, and the ripples and foam of the water lend themselves well to the tilted camera.



THE SHADOW OF THE LAW. Simple, yet extremely effective, this study of a London policeman controlling the traffic owes everything to camera angle and angle of lighting. Taken early in the day, or late in the afternoon, when the low sun casts long shadows. The intrusion of any other subject or shadow, or even clearly defined markings on the roadway, would have spoiled the effectiveness of this study

Fox Photos



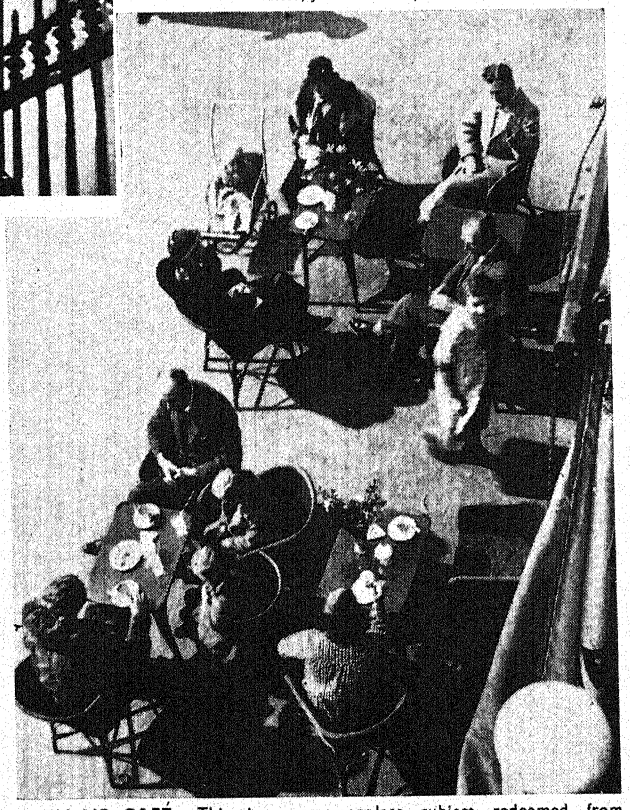
THE PORTICO—AS THE CAT SEES IT. Taken by the light of a street lamp concealed behind a pillar, a very ordinary portico is made into an original and effective composition. The lower photograph, though rather low in interest, has been included to illustrate the perspective given from a natural high viewpoint

Photos, A. M. Melland ; M. W. Brampton



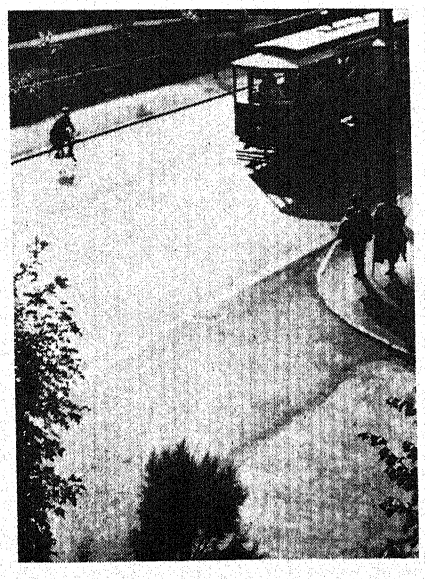
EXPERTS. Here, again, the remarks made concerning "City Gossip," in p. 71, apply. From the normal viewpoint it would be difficult to convey what was actually happening

Photo, John H. Ahern, F.R.P.S.



OPEN-AIR CAFÉ. This is a commonplace subject redeemed from banality by the angle from which it was taken. It would have been even better had not the photographer unfortunately attracted the waitress' attention at the moment of exposure

Photo, Associated Press



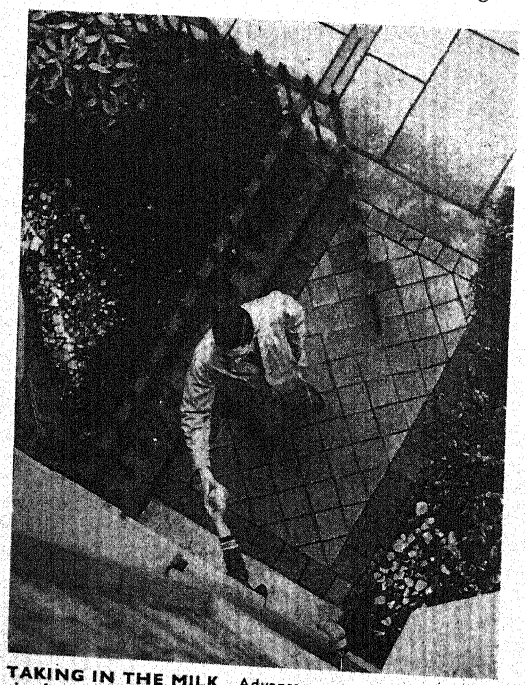
ANGLE SHOTS ON THE SCREEN

We have seen the advantages of angle shots, when properly utilized, in still photography. In cinematography even greater dramatic force can be obtained by the effective use of unusual angles. (See *Action Photography*)

In cinematography angle shots have, perhaps, an even greater significance than in still photography. The " message " of a still photograph is essentially brief, and the angle shot must either tell the whole story or fail to justify itself. The progressive nature of the motion picture, however, gives the angle shot a much wider application, enabling it to heighten drama and establish contrast.

The significance of the motion picture angle shot is definitely dependent upon the context, and unless the context is helped by the angle shot the latter becomes merely a " stunt "—bizarre and meaningless.

Impressions of speed, power, immensity, and so forth, are usually emphasized by a low viewpoint with the camera tilted upwards ; insignificance, destiny and diminution of effect are suggested when a high viewpoint is used and the camera pointed downwards. The normal horizontal camera " angle " adds nothing to the mood or emotions inherent in the matter being portrayed.



TAKING IN THE MILK. Advantage can often be taken in cine frames of an almost vertical camera angle to arouse interest in the unusual and to present pictorial results
Photo, I. Eustace Blyth

To make the most effective use of angle shots they should be carefully thought out in relation to the film in which they are to be used. As far as possible they should be specified in the working script, and not left to last-minute inspiration of the cameraman or director.

A single example must here suffice to show the power of the angle shot to vary the emotional mood of a subject portrayed—in this case a man working at a printing machine. A normal camera angle would produce a simple record of a man operating a printing machine. However, by adopting a low camera angle from behind the machine, with the " works " looming large, and the man intermittently visible through the pulsing mechanism, it is possible to convey the idea of Man's Slavery to the Machine : the impression would be strengthened by dramatic lighting, throwing on the man's face shadows of the moving rods and wheels.

A low viewpoint, looking up towards the man and emphasizing his stature in relation to the machine, would convey the opposite idea—Man's Mastery of the Machine. Yet other camera angles would suggest purely factual ideas : how a printing machine works, and so forth.

A degree of artistic and dramatic sense is essential if the utmost use is to be made of the motion picture angle shot. Originality is helpful, too ; but originality without a sense of fitness may result in freak angles, pretentious and inane.—*H. B. ABBOTT.*

ÅNGSTRÖM UNIT. A ten-millionth of a millimetre : the accepted standard of measurement in dealing with the wavelengths of light. Thus a wavelength of a tenth of a millimetre would be expressed as a million Ångströms, or 1,000,000 A.U. The name is derived from that of the famous Swedish physicist, Anders Jonas Ångström (1814–74).

	Approximate Wavelengths of Visible Light in Ångström Units
Red (Upper Limit)	7,200 A.U.
Yellow	5,800 A.U.
Green	5,000 A.U.
Blue	4,500 A.U.
Violet (Lower Limit)	4,000 A.U.

The Ångström unit is also frequently used for the measurement of X-rays, though for precision work smaller units are used.

ANIMAL PHOTOGRAPHY: STUDIES OF WILD LIFE

Arthur R. Thompson, F.L.S.

Author of "Nature by Day," "Nature by Night"

Demanding photographic skill, knowledge of Nature, and an abundance of patience, animal photography is essentially a subject for the specialist and enthusiast. In this article, which is complementary to others dealing with the photographing of dogs, cats, horses and birds, the difficulties, scope and methods of photographing mammals in their natural environment are fully discussed

See also Cat, Dog, Natural History, Zoo Photography

THE world has long ago ceased to marvel at the results obtained by animal photographers. Too many people do it successfully for there to be any miracle, but the camera as an aid to natural science is of immense value.

Photographs of stuffed animals do not come under the heading of animal photography. Many such photographs are taken and published, and there is no objection to it, provided they are not put forward as photographs of living animals. Good as taxidermy is, it seldom, if ever, deceives an experienced field naturalist.

Many books illustrate mammals and fishes with photographs of fine technical quality, manifestly dead. This is photography applied scientifically, and is clearly justifiable.

Is it desired to photograph animals for amusement, or are you a naturalist anxious to make photography assist? If the latter, you can add greatly to the value of your work by keeping careful records of your observations. The animal photographer should see more of a species photographed than the observer content to watch at a distance with binoculars. He also spends more time making his observations of that particular species.

Technical Perfection Essential

If it be admitted that the object is to obtain photographs of scientific value, it will be seen that the scope is wider than at first appears, for not only does the photography of dead creatures occasionally hold a place, but the further matter of photographing animals under some form of control has to be considered. Negatives must be as technically perfect as they can be made. If the result is pictorial, so much the better, but technical quality should never be sacrificed to obtain pictorial effects.

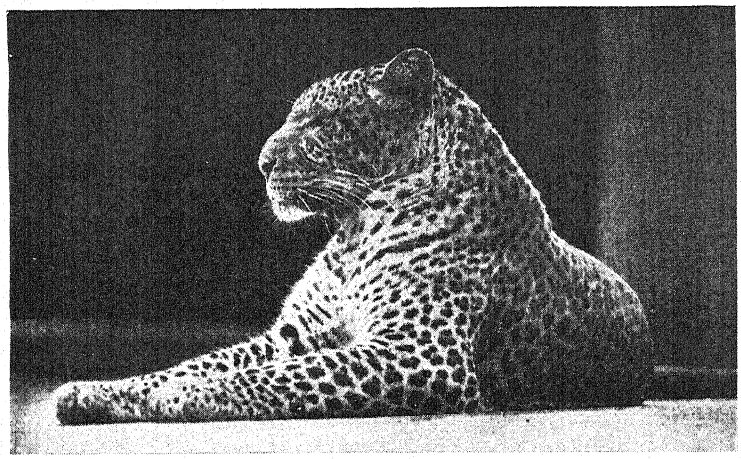
The bird photographer has one advantage over the photographer of mammals. Birds have eggs and young. The eggs, at any rate, are stationary, and the young are usually in the nest for some time. There is, therefore, a known place to which parent birds will return time and again. The nesting season is the bird photographer's busy time. Birds are often photographed away from nests, but this is more difficult and opportunities are much fewer.

Mammals and Their Young

It might be argued that mammals also have young; but the young are almost invariably concealed, often underground, and feeding is at night. Moreover, mammals born on the surface, such as calves, and fawns of deer, leverets of hare, first see the world in what is called a "precocious" state. That is, they are clothed in fur, have their eyes open, and are able to move about a few hours after they are born. The young can be photographed, of course, but it is no use putting up a "hide." Even if the parent would face it, the chances of the young remaining where they were focussed are negligible. Mammals which produce young and sleep underground provide workable subjects usually by flashlight.

It is difficult to lay down hard and fast rules. What naturalist knows where a mole will appear? What a tremendous wanderer is the otter! To see an otter in a stream today is almost a good enough reason that it will not be there tomorrow. Stoats and weasels move underground a lot, but, except when they have young, are always travelling. It is no use putting up a hide. Both stoats and weasels will often return to a kill, but they are suspicious and there is no chance to get them used to a hide.

Mammals are warm-blooded vertebrates which suckle their young, and the group



RECORDED BY A REFLEX. A fine example of a photograph taken at a zoo with a reflex camera. Note the repression of the background, frequently far too well defined in pictures of caged animals. Here the result is due largely to the use of a long focus lens

Photo, J. E. Saunders; Graflex camera, Dallon lens f5.6, 1/25 sec., Imperial cut film

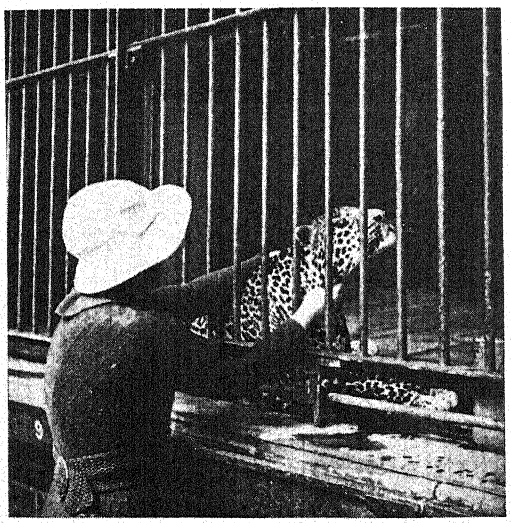
includes whales, porpoises and dolphins, as well as various quadrupeds. Mammals constitute an important class of life, and their photography provides ample scope for ingenuity; the diversity of the modes of life and environments in which they exist present difficulties not usually encountered in other forms of photography. Successful photography is largely a matter of opportunities. If these are seized whenever possible, much time may be saved.

For success there are two essentials: a sound working knowledge of photography, and a knowledge of the creatures being photographed; the latter is the more important. The photographic side may be met to a great extent by using a meter for exposure, and time and temperature, or the factorial method, for development. But expert knowledge of the subject will prevent many a spoilt negative.

Cameras and Shutters

Almost all cameras can be used for some forms of animal photography, but box-form cameras and cameras fitted with single-extension bellows are only suitable for comparatively large animals. To obtain photographs of small creatures, double-extension bellows is necessary. Until recent years the choice of camera rested between some form of stand camera and the reflex. To these must now be added the miniature. The stand camera is the most used. It should possess double extension bellows—triple extension is better. Size of plate is a matter of opinion. Quarter plate is good, and negatives, if critical, produce perfect lantern slides and will stand all the enlargement required. The camera stand is very important. The photographer, sitting cramped for hours in a "hide," is very liable to touch the tripod, and if it is flimsy the subject must be re-focussed. When attempting to photograph timid creatures, whose senses of hearing and sight are acute, re-focussing is almost impossible.

The shutter is most important. Many workers use the roller blind, and there is no reason why a focal plane should not be fitted to a stand camera. Many makes of between-lens shutters will do good work, but most are noisy. Elimination of sound in the shutter is most desirable. A shutter much used by nature photographers, especially bird workers, is the Luc. This makes less noise than most metal-leaf shutters and has the further advantage that the length of exposure is



CAGE CLOSE-UP. Where the recording of the whole picture subject is required the miniature camera has a definite advantage in animal photography. This picture, taken with a miniature, could not have been obtained with a larger camera in the same circumstances

Photo J. E. Saunders · Super Ikonta camera, 8-cm. lens

governed by the hand pressure put upon the wire release. Thus, if the sky becomes overcast the shutter does not require resetting. All the photographer has to do is to bear in mind the light condition when exposing.

Studio shutters are seldom quiet enough, and are usually too large to fit into a camera which must be portable. The shutter I use most consists of two hinged flaps of aluminium, lined with black felt, fitted behind the lens and opening into the camera. When fully open, electrical contact is made, so that when flashing is contemplated the action of the shutter itself fires the flash. This shutter is quite silent, and as it moves inside the camera the creature being photographed is unaware of it.

It is a good working rule to use the stand camera whenever possible. It is an instrument of precision and makes for careful work. Ninety per cent. of natural subjects can be photographed with the stand camera, but it must be a solidly constructed instrument, and not overloaded with unnecessary fitments.

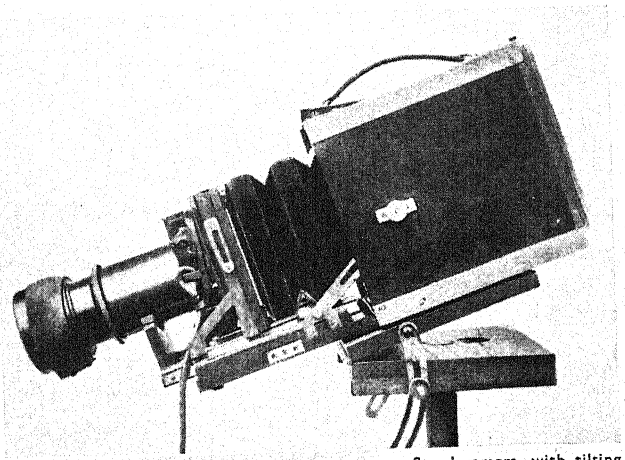
The reflex is a camera of double capacity, as it can be used as a stand camera with focussing screen. Most focal plane shutters are noisy, and the bellows extension of reflexes is limited in most makes. I use the reflex for flying birds, chiefly because a fast exposure is necessary; and for mammals when I am not in a position to make the stand camera do the work. But the reflex, when used as a reflex, is liable to produce disappointing results owing to lack of depth of focus.

It will be remembered that the lens seldom has a focal length of less than six inches. Stopping down is only a partial solution, because the reduced light on the top focussing screen makes it difficult to discern the image well enough to focus accurately. The objection as to lack of depth of focus applies chiefly to the photography of small creatures.

The miniature camera is the latest addition to the apparatus of the serious worker. Its special features, characteristics and use are fully dealt with under its own heading.

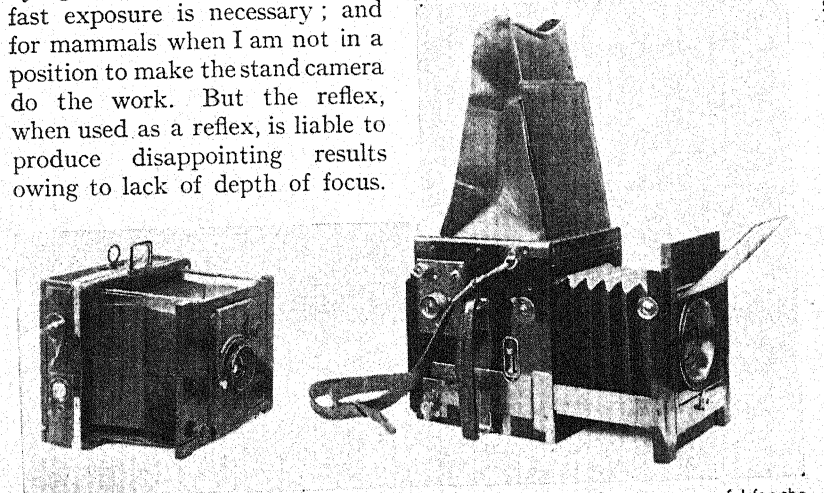
The following are some of the more important accessories:

A useful tripod extension consists of three lengths of wooden rod, a half-inch square and three to five feet long. At one end of each rod is a square brass tube three inches long.



Stand camera with tilting top and telephoto lens. Used in the "hide," the apparatus must be absolutely rigidly erected

The rod fits into the tube for one and a half inches. The other one and a half inches of square brass tube slides on to the end of the camera tripod leg. The camera tripod with an extension rod on each leg can thus be raised some feet above its usual maximum; useful



REFLEX AND PRESS CAMERAS. Both the reflex and press type of camera are useful for the animal photographer, though the miniature camera is tending to supersede them

Photos, A. R. Thompson, F.L.S.

for birds' nests and similar subjects, but is less often required for mammals.

A rubber band, 1½ inches wide, placed round telephoto lens is useful in steadying camera during exposure. It can be cut from an old motor tyre inner tube. The ends should overlap and be secured by two studs. Orifices for the studs should be cut with a suitable punch to ensure clean holes. With this ring on the lens, the reflex held in the hand while exposing is steadied by gently touching with the rubber any solid stationary object, such as a tree or railing.

Reflex resting rod, 18 inches long, screwed on to the bottom of the camera with an ordinary tripod screw, is also of value. The rod, which is tapered, projects in front of the camera. In use it is rested on wire-netting to keep the camera steady. It is useful at the Zoo and other places where animals in confinement are being photographed.

The Animal and the Photographer

A dummy camera may be used. This is an old camera, or something which bears a resemblance to a camera. An imitation lens, such as the bottom of a glass tumbler or bottle, is important. The lens, looking like an eye, sometimes disturbs many animals. The dummy is used when a hide is not desired, or is impracticable. When the animal to be photographed is used to the dummy, the camera proper takes its place.

A velvet cover for back of camera is used when a drawn dark slide is left in position for some time. It prevents fogging of plate or film and is almost essential. It also secures and hides the drawn flap of the dark slide.

Telephoto lenses require accurate focussing and give little depth, consequently margin of error is small. Illumination of subject is less brilliant than that given by an *f*4.5 anastigmat. The weight on the end of the reflex adds to the difficulty of holding the camera steady; but for throwing objectionable surroundings out of focus the telephoto lens is useful, and has the advantage of giving a larger image.

The term used to describe the erection in which the photographer conceals himself and the camera is a "hide." The usual type is a square framework over which is fitted some opaque material. Brown canvas is good in winter but too hot in summer. Casement cloth of suitable colour, green or brown, is often used. Within reason, the size of the hide does not matter. It must be capable of being dismantled, and the smaller it is when folded for transport the better.

Working with the Hide

Methods of working the hide depend upon the subject it is desired to photograph. If placed too near to start with, the subject may desert. Once an animal has taken to the hide, no matter how far away, the closing-in process may be fairly rapid. Suppose it is desired to try to photograph fox cubs in a hedge bottom—observation shows that the youngsters play in the field outside the entrance to the earth. A hide in the field is necessary. The fox is shy and the vixen will lead her cubs away if anything appears which she dislikes or does not understand. Put the hide up one hundred yards away. Two days later, if all is well, close in to fifty yards, and then next day to twenty-five yards. In a week the hide should be ten yards from the earth entrance, if it is intended to use a telephoto or long focus lens and it is desired to show several cubs on the plate. If only one or two animals are to be included, the hide should be a little closer, otherwise the animals will be small on the plate.

Value of Setting

Surroundings, if properly handled, add to the interest and beauty of a nature photograph. Holes in the hide for lens and observation are necessary. Further observation apertures in the sides and back help to relieve the monotony of waiting. Nevertheless, the fewer holes in the hide the better; they look black, are obvious, and liable to cause fear. When the hide is getting near its final position, clearing away intervening growth should be commenced. Do it gradually and leave the herbage nearest to the subject until last. By clearing in this way the bird or mammal is enabled to get used to the gap in the undergrowth.

Tying back is better than cutting away, because when one has finished photographing, the scene can be restored quickly and naturally. Do not waste time trying to photograph the impossible; if the subject is badly lit, or in unattractive surroundings, or in a bad position, find another example.

Many pleasing photographs may be obtained at zoos, public parks, etc. Suitable cameras are reflex and miniature. This subject of zoo photography is fully discussed under its appropriate heading.

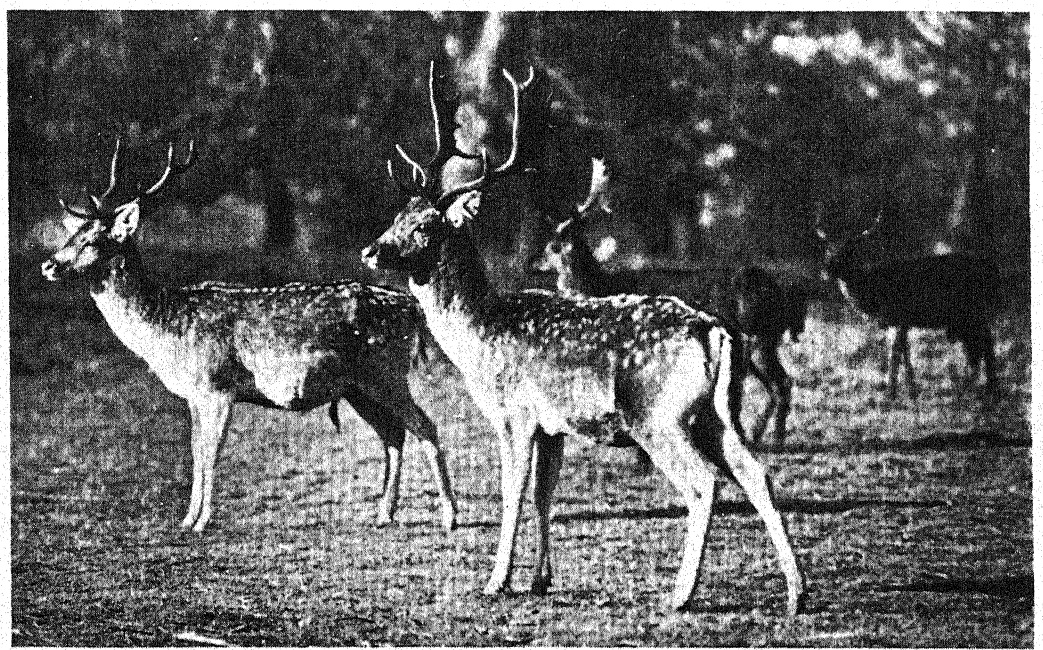
Flashlight Photography

Animal photography by flashlight, which has come much to the fore since the Great War, is most fascinating. Its chief use is to obtain pictures of creatures which move at night ; but when exposures have to be made in daylight in badly lit places, judicious use of magnesium powder will often put that extra moulding and brightness into negatives which might otherwise be flat and under-exposed. I do not care about using any form of flash on diurnal birds or mammals ; it is bound to cause fright. With creatures of the night it is less terrifying. If the animal happens to be looking straight at the flash when it is fired, it is surprised into an involuntary start and bolts ; but I have known a badger, after being flashed, not only remain out of the hole but actually wander off into the darkness.

There are at least three forms of instantaneous photography by flashlight. The first is to allow the flash itself to determine the length of exposure. The camera shutter must be silent. If not synchronized with the flashing apparatus, some arrangement must be made to open the shutter before the flash is fired. It is not possible to set the shutter open and leave it until the animal appears, because the photographer must be in position, silent and still, before dusk. An open shutter in such a light would soon over-expose the plate and the final image would be a transparent animal with surroundings plainly visible through its body.

It is not difficult to make the fully open shutter fire the flash. All that is necessary is to arrange for the movement of the opening shutter to make electrical contact between two ends of copper wire, thus completing an electrical circuit. If a flash-bulb is used the battery of a pocket flashlamp is all the power needed ; if magnesium powder, the principle of ignition is to pass current through a short length of thin fuse-wire which is covered with flash powder. The current makes the fuse-wire red hot, which ignites the powder.

Flash-bulbs are convenient and safe. The battery is tiny, so that this type of flashing apparatus is easily carried ; but the light is not powerful and has little penetration. To get the best effect a reflector directing the



PHOTOGRAPHY IN THE PARK. The fallow deer that are to be found in many of our parks are good "sitters" for the animal photographer. This picture was taken from a "hide" with a reflex camera

Photo, A. R. Thompson, F.L.S. Dallon f5.6 lens (stopped down to f8), 1/50 sec., Kodak flat film

light towards the animal to be flashed is a help. The absence of a reflector can be remedied by using very fast panchromatic plates. Such plates enable the lens to be stopped down to *f*16 or *f*22, which means good depth of focus. Another thing in favour of flash-bulbs is that the electric circuit can easily be checked when in position. An ordinary torch bulb is screwed in place of the flash-bulb. The shutter is opened, and if all is well the bulb lights, thus proving that circuit is properly made and the battery is carrying sufficient current. After testing, if the circuit is functioning correctly the torch bulb is replaced by the flash-bulb.

Flash Powder Exposures

Flash powders vary and some are too hygroscopic for work in the open. When the exposure is governed by the flash, *i.e.* when the shutter remains open from just before the flash firing until immediately after, instantaneous ignition and a short flash are essential. A wait of two or three hours at night is usual, and an unsuitable powder collects moisture readily. When contact is made, some seconds elapse and then follows a long, hissing flash. No animal will tolerate such treatment, and hopeless movement is the result. Johnson's or Kodak flash powders are suitable for night work. Flash powder is cheaper than flash-bulbs, and because the amount used is at the discretion of the photographer, the light when fired can, if necessary, be far more powerful.

Flash powder should be handled with care. The ignition results in a mild explosion. On damp nights electric current is liable to creep in an unaccountable way. On one occasion at a badger earth, after waiting an hour or two, my flash powder fired. I had not fired it. Suppose that had happened while I had been pouring the powder on to the fuse-wire. Almost certainly permanent blindness would have been the result. Since then, flash powder is poured on to the fuse-wire at arm's length with head and eyes averted.

Methods of Synchronization

The second method of night flashing is to synchronize the flash with the shutter. The shutter then determines the length of the exposure—not the flash, which should be at its peak when the shutter works. Many devices to secure this have been thought out. The general idea is two distinct electric circuits. One circuit links up with the flash powder. This is fired, and the flash throws up a thin, hinged copper plate. The copper plate touches and makes contact with two wires, thus completing the second electric circuit. This second circuit operates an electro-magnet which releases the shutter of the camera.

Another idea is to arrange a spring which is prevented from releasing the camera shutter by a piece of cotton passing through the flash powder. As soon as the flash powder ignites, the cotton breaks and the spring releases the shutter.

This second method of night flashing, controlling the length of exposure by the camera shutter, is capable of most attractive pictures. There is, however, less certainty than with the more simple method of timing the exposure by means of the length of flash, but the better results obtained justify the risks of failure.

The Animal Photographs Itself

The third method of obtaining photographs of night animals is an adaptation of either of the above methods of exposing to make the animal photograph itself. It can be done by putting down a thin piece of board on which the animal should tread. Electric contact is made and the flash and exposure follow, whatever system is being employed.

In this manner the contact made by the animal can be arranged to fire the flash. The explosion of the flash, by lifting the copper plate, completes the second electric circuit and the electro-magnet releases the shutter. The board should be covered with dried mud, or camouflaged in some way or other, otherwise it will intrude and spoil the picture.

A simpler method in some ways, and one which works with greater certainty, is to stretch a piece of thin black cotton across the place where the animal must pass and focus the camera accordingly One end of the cotton is tied to a tree or any firm stationary object. The other end is secured to a piece of light spring brass. This spring brass is one end of an electric circuit and

is set nearly to touch another piece of brass or copper. When the two touch the circuit is complete and the flash is fired and shutter released. A very slight pull on the cotton draws the two contacts together. Adjustments must be delicate. If the spring brass is too stiff, the animal feels the cotton; if too easy, a light breeze may cause sufficient tension to draw the contacts together.

The objection to this form of night flashing is that it is mechanical only. It may get a good picture, but there is no observation. To me it lacks interest, for it is actually seeing these night creatures in a wild state which is so fascinating. There is, however, much to be said for it when it is a matter of photographing dangerous carnivorous animals abroad. In the British Isles there is less to recommend it.



IN THE FLASHLIGHT. The badger moves abroad mainly at night and must therefore be "flashed." This photograph of a male specimen was obtained just as he emerged from his sett, the photographer using natural cover

Photo, A. R. Thompson, F.L.S.; Cooke f5.6 lens at f8, Kodak flat film

I now propose to give briefly a few hints on photographing particular animals.

Aerial Photographs of Whales

Whales and other swimming mammals have so far been photographed very little in a wild state. I have seen a few photographs taken vertically downwards from aeroplanes. These as a rule are very effective. Vertical photography from aeroplanes is not difficult. The camera is fitted pointing vertically downwards; the lens is set at infinity and the shutter is focal plane. The aeroplane should be flown at five hundred to a thousand feet, with the engine throttled down to produce minimum flying speed commensurate with safety. If possible, flight should be into the wind, which helps to reduce the "ground speed."

Photographs from the air of living, moving subjects from a height as low as five hundred to a thousand feet should be tried with a shutter speed of 1/250 second or less, with a lens aperture of *f*4.5. Fast aeroplanes are less suitable for this type of aerial photography than slow. It is a form of photography not likely to be practised by many photographers, and it is as well to remember that, generally speaking, height is safety in flying; low flying over the sea must be regarded as risky. Opportunities of photographing large marine animals in British waters are not as rare as might be imagined, but it is essentially a wealthy man's amusement.

Speed Shutters for Seals

The British seals, especially the Atlantic or grey seal and the common seal, are still found in fair numbers about our northern and western shores. A few common seals appear off our eastern shores, but with less regularity and in smaller numbers. Chances of obtaining photographs sometimes occur, both when the animals are swimming and on land. Almost invariably speed of shutter is necessary, and the reflex camera comes into use, or the modern miniature camera. The stand camera is only useful in making pictures of young seals; even then, reflex or miniature cameras can turn out work at least as good Telephoto lenses are obviously a very great help.

The badger is nocturnal and therefore must be flashed. It is one of our shyest and most wary mammals, with acute senses of scent and smell. Sight is poor. A hide is unnecessary; natural cover should be used. A normal badger sett is in a hollow well grown with trees and shrubs, and a pool of water in the bottom. An occupied entrance can be recognized by freedom from dead leaves, smoothness of the floor and earth recently scraped out. If there is doubt, insert a bracken frond or leaf spray into the opening. It will not stay long if Brock is at home.

Setts in gravel pits and other open places are pleasant to work at, but because they are so light badgers tend to emerge later, which means a longer wait. It is no use working at any hole where the only position for the camera is against the skyline.

The Tricky Badger

Place the camera above the hole, pointing slightly downwards; photographs taken from below the hole usually show head and shoulders only. A photograph of a mammal which does not show legs is a failure. The objection to setts in well-wooded places is the attention received from midges, mosquitoes, flies and other pests. This nuisance must be tolerated; the advantages outweigh it. The wooded sett is quiet; Brock is less suspicious; the camera is not obvious in the poor light with a background of trees and shrubs; dusk is soon felt and the badger issues forth earlier than from open setts.

Clearing herbage away from the entrance of a sett should be minimum; searching usually produces a hole where no clearing is necessary. The camera must have a good viewpoint and the photographer must conceal himself so that he can see without moving. Everything must be in position well before dusk, an hour is not too much. The sett must be on the weather side of the photographer. Spring, summer and early autumn are the best times.

Smoking is prohibited, and when all is in readiness and the period of waiting commenced the silence must be absolute. If you must move, do it very slowly, so that if a badger appears just when you are bringing up one hand to brush away an insect, no harm is done. You just keep your hand exactly where it was. After looking for a few seconds, provided your hand does not move, Brock is satisfied. The observer must be so still and silent that to the badger's senses he is not there at all. Only thus will a badger allow itself to be seen and photographed. If nothing has happened by midnight (B.S.T.), something is wrong. Brock is not at home, the weather is unsuitable, or he knows that someone is outside the earth. As to weather, wet, cold or windy nights are least suitable; still, warm nights are best. From the middle of June, July and August, cubs make it necessary for the observer to be concealed farther from the earth, or up a tree. Otherwise the playful young may blunder into him.

Sunning Places

Although nocturnal, badgers occasionally come out and enjoy sunshine. The sunning places are not difficult to find; they are seldom many yards from the sett entrances. There are at least two tracks by which the badger can enter or leave. At the time of writing (1937) I do not think badgers have been photographed sunning themselves. It would be an accomplishment. These sunning places are used irregularly and are often neglected for days or weeks. It is the type of photograph where arranging the apparatus to make the badger photograph itself would be excusable. But that would not be easy. The position where a badger lies can only be ascertained by observation and an ability to read signs.

Photographing the Fox

The fox is commoner than the badger, so that opportunities of obtaining photographs are more frequent. Photographic procedure is much the same as for the badger, except that the fox sometimes comes abroad in daylight and leaves its earth earlier in the evening. The entrance to a fox's earth is less clean than a badger's, and footprints are distinctive. Otherwise there is not much difference, because many foxes lie up in badger setts. Both animals are wanderers, but there is more regularity in the badger's movements. When a sett becomes tenanted by a badger the animal will probably stay a month or more, if undisturbed. The fox may stay only a night or two. Fox sight is good, so a hide may be necessary. Earths in open places should be worked with a

hide, or left alone in favour of an earth in a darker place.

Snapping the Cubs

Adult foxes should be attempted at night by means of flashing apparatus ; fox cubs by night or day, for cubs play freely around their earth in the daytime. They become easier to photograph as they grow older. That is because they become independent and more prone to wander off alone. When the cubs first see the light of day they do not issue forth without the vixen. This provides a photographic difficulty. The photographer and hide must be on the weather side of the fox earth and cubs, otherwise the cubs will pick up the scent ; but the vixen approaches her nursery up-wind, and so knows that there is a stranger in the vicinity. She stays away and the young cubs do not venture forth. It may be worth while trying for a photograph, because sometimes the vixen lies up with the cubs. A good light is necessary ; fox cubs are active, and exposure must be short. The longer the focal length of the lens the less ambitious should be the photographer to get too near his subject ; depth of focus is limited.

In daylight the miniature camera should produce first-class results of cubs at their earth, the shortness of focal length of the lens giving it an advantage over lenses of six-inch focus or more. A freshly killed rabbit or other bait is often placed near a fox earth. It is something to focus on, but the dead rabbit intrudes in the photograph.

Stoat and Weasel

These move in the daytime as well as at night. Unless they have young, both are wanderers and may use any of scores of rabbit burrows. Both run well, and all movements are quick and jerky. It is not easy to eliminate movement in a photograph. It is possible to photograph either in a wild state, but the time required may be a serious deterrent to many a would-be photographer. Naturalists often witness a rabbit hunt and see the kill. The stoat sheers off when disturbed, but will usually return as soon as it feels that the coast is clear. The best photographic opportunities are when either of these animals is discovered dragging the carcase of a freshly killed victim. They are more impatient to return then than when disturbed at a kill. Photographs can be obtained with the reflex held in the hand.

If either is seen moving in a leisurely way, the place where they were last seen should be approached quietly, with the reflex shutter set and dark slide drawn. The photographer must be still, and if the squeal of a rabbit can be imitated, matters are simplified. Focus must be accurate, and a shutter speed of about 1/100 second given ; a second chance at the same stoat or weasel is unlikely, the noise of the shutter proving too much. The rabbit's squeal can be imitated sufficiently well to deceive either stoat or weasel by nearly closing the lips and drawing in air sharply with a squealing sound. It is easy to learn and is useful with other animals. When a badger first emerges from its sett, it sits just outside the entrance. That is the time to expose. But sometimes it moves straight out into the darkness ; a rabbit's squeal will cause it to stop and look round. That applies to the fox also.

Use of Traps

Stoats and weasels are easy to trap alive, and can then be photographed under control. The trap is made of wood about two feet long, like a square-shaped tunnel. There is a spring door at each end and a small moveable platform in the middle. When pressed down this platform releases the end doors together. Such a trap placed along hedgerows, close in, is efficient. Most animals move under cover in preference to the open ; no bait is necessary, but a small dead bird or mouse may help. The objection to the long trap is that it frequently catches unwanted animals. Rats, young rabbits, and even an occasional little owl, will necessitate resetting.

As to control, I photograph between two sheets of plate glass held apart by a wooden frame. The bottom of the enclosure is natural and the background also consists of herbage growing naturally. Focus, set shutter and draw dark slide before inserting the stoat or weasel. Temperature soon rises between glass. An uncomfortable animal photographs badly, and unless the result is a good natural likeness there is nothing to be said in favour of control. Reflection may

be eliminated by holding a black focussing cloth immediately behind the camera.

Carnivorous animals, when first confined, behave differently from rodents. They are more intelligent and make little effort to escape so long as they feel they are being watched. They save their energy until they are alone. The photographer must know quite a lot about the ways of the animals he is trying to photograph, and with that knowledge exposures of one or two seconds on controlled animals, with the lens at *f*16 or *f*22, become easily possible.

Photographing behind glass is not very romantic, but in skilful hands it produces results which cannot be obtained in any other way. It is foolish to criticize such photographs as unnatural. I have shown such photographs to some of the finest nature photographers of today, and none has known that they were taken between glass until told. The same method can be used on other mammals, but it should be a last resort. Glass, no matter how careful the photographer may be, is better left out. Much can be done in the way of control without glass with most small mammals, but the *Mustelidae* are too active and impatient to lend themselves to simpler methods.



THE OTTER OBLIGES. Only by patience, keen observation and swift action can one obtain a photograph of the elusive otter such as this
Photo, Neville Kingston

The polecat may have been, and most probably has been, photographed in a wild state ; but I have no knowledge of the pine marten ever having been successfully photographed. The former still exists and breeds regularly in remote parts of the British Isles ; central Wales is its stronghold. The pine marten is on the verge of extinction. The polecat is a great rabbit-killer, and the mammal photographer with time to spare should succeed. But the rarity of the pine marten and its arboreal habits make it one of the most difficult photographic subjects in the British Isles. Under control, neither polecat nor pine marten should prove more difficult than stoat or weasel.

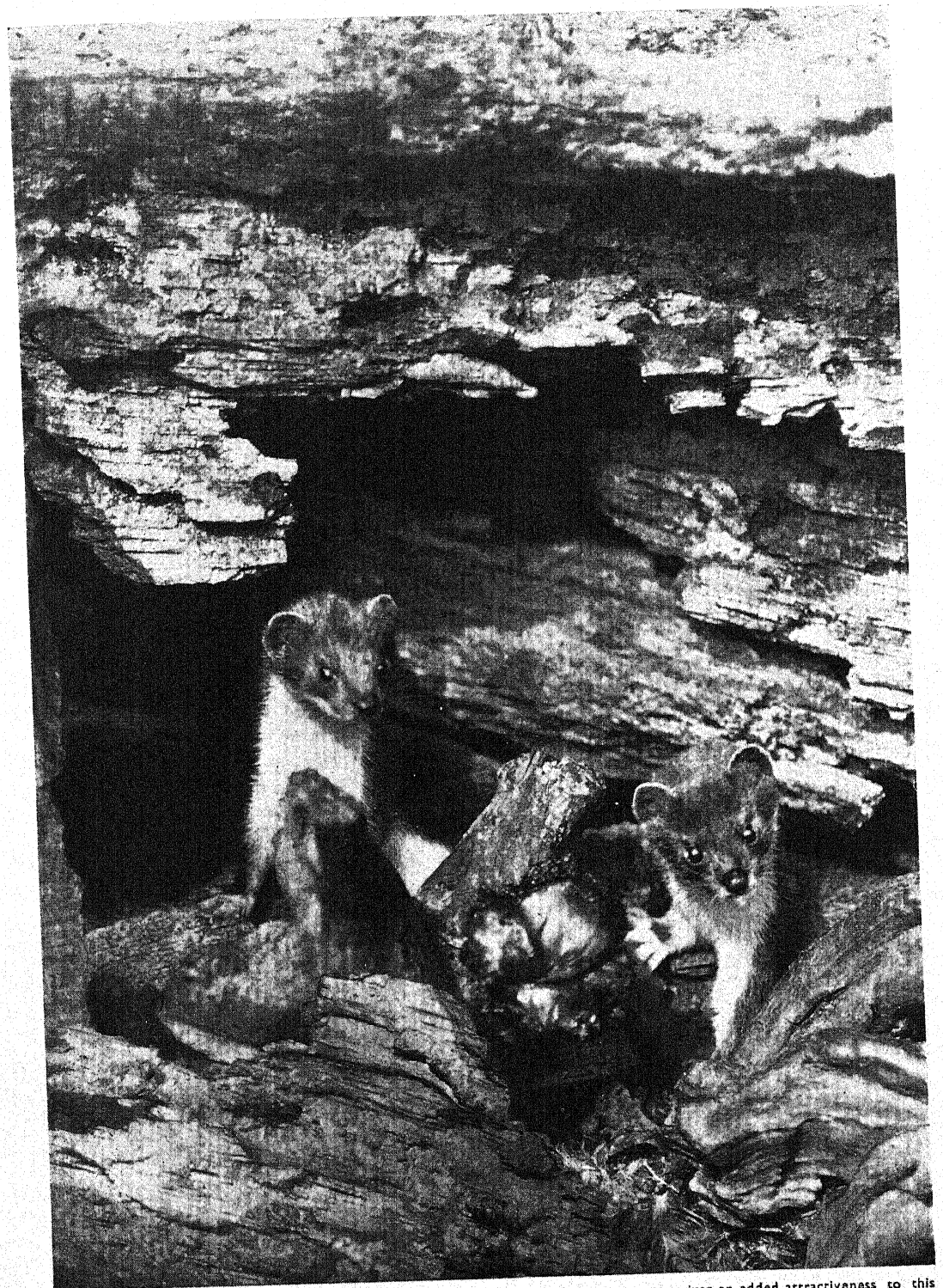
Problem of the Otter

The wild otter is a difficult problem. In captivity it is a comparatively simple subject—just the usual animated ball of quick movements, curiosity and mischief. An ordinary subject requiring patience, not much worse than an active puppy.

Wild, the otter requires as much care as any animal I know. If a holt containing young can be found, put up a hide and work as soon as possible. The young will be removed as soon as the female or bitch otter finds out that they have been discovered. In marshy, water-logged country like the Broads the young are produced in reed beds. In Essex, and no doubt other counties where land has been reclaimed from the sea, otters haunt the neighbourhood of marshes and the young are concealed in suitable hollows about sea-walls ; or sea-wall draining ditches. The draining ditch is narrow, two or three yards wide. The otter cubs are close to the ditch and the female approaches by swimming gently along the ditch, reaching the cubs by landing through an opening in the reeds.

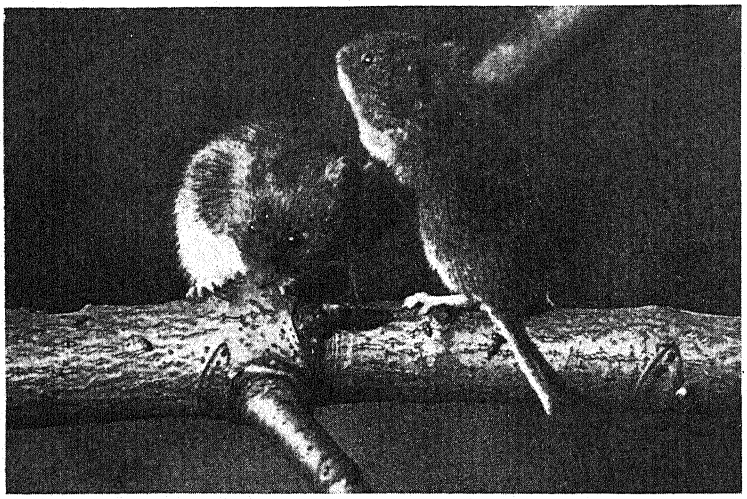
The camera can be erected on the opposite side of the ditch, placed low and concealed by herbage. If the locality is lonely, the female will visit her cubs in daylight, especially early morning and evening. Be prepared to photograph by flashlight, if necessary.

Rodents are simpler subjects. Rabbits can be photographed outside their burrows. Choose a burrow well tenanted and photograph day or night. A hide placed in a



CAUGHT IN A CORNER. The expression of surprise exhibited by these two stoats gives an added attractiveness to this charming photograph, which was secured after a most stealthy approach to their secret rendezvous

Photo, J. T. Newman Reflex camera, Cooke 11-in. lens, 1/100 sec., f8



CONTROLLED SUBJECTS. Excellent pictures can be obtained of certain small wild animals if they are placed in a natural setting. Above, a controlled photograph of two bank voles

Photo, A. R. Thompson, F.L.S.; Cooke f4.5 lens at f8, 1/10 sec., Barnet super speed plate

warren can be occupied towards evening well before sunset and exposures with a reflex made freely. A telephoto lens is a help, and the hide should have an opening on each side at a comfortable height to use the camera when the lens protrudes through the hole.

Rats, brown or black, can be photographed best by night, but the brown rat comes abroad in the daytime in lonely places. Municipal rubbish dumps are often rat-infested and far removed from human dwellings. Rats run about day or night and runs are well marked. A hide should be erected and the camera focussed on a much-used track. A large stone or tin should be placed on the run just out of the picture. The travelling rat will pause in its surprise and give the photographer a chance to expose. House mice can be practised on at home by flashlight. It saves time to feed for a few nights in the same place. Quiet is all that is necessary. Field mice can be flashed immediately outside their holes. If there is doubt as to whether a hole is occupied, a couple of dead leaves pushed just inside the entrance will be cleared the first night if a mouse is within.

Rodents—Difficult and Easy

The dormouse and harvest mouse are climbers, so photography in a wild state is attended with much uncertainty. Chances of success are remote. It is better to photograph under control. For the dormouse, a suitable branch—hazel is natural—is focussed. The mouse is placed on the branch and held gently in position until it settles down. Lift the hand clear and expose. Harvest mice are the easiest of all, because they are poor jumpers and less liable to escape. Focus on the upper part of a twig or some wheat-ears and introduce the mice on to the lower part. They will run upwards and provide plenty of opportunities for making attractive negatives.

The insectivorous mammals, hedgehog, mole and shrew, owing to their habits, do not repay time spent on photographing in a wild state. The mole often comes above the ground. Catch it and expose with reflex. The animal must be on very hard ground, or it will burrow before an exposure can be made. Shrews are tremendously active, so exposures must be short. Between glass is the easiest method. Bats can be photographed in suitable surroundings under control, but some roosting places, especially caves, allow flashing in situ.

A Tumbler Tip

One method of photography of small mammals which I have used with success is to put an ordinary glass tumbler on the ground and get the camera all ready and focussed. The mouse or shrew is then placed under the tumbler, and as soon as it is in a good position the glass is lifted away and the exposure made. The sitter usually then escapes. There is no reason why this method should not be tried for rats and water voles, substituting a large glass jam pot for the tumbler.

The short-tailed field vole can be photographed by day either in a run or just by its hole. The run will have to be opened out, or the vole will not be obvious in the

picture. Bank voles love ivy-covered banks and show themselves so seldom that photographing in a wild state is heartbreaking. They make attractive pictures under control, and because, unlike field voles, they climb about low thick hedgerows, are not unnatural photographed on a branch. This, of course, makes it easier to focus than when a mammal must be on the ground.

Water voles I work from the hide with reflex and telephoto lens, taking care that the colony is well populated. Some observation is necessary to ascertain where the mammals use the land. In some streams these mammals multiply tremendously until disease thins them out. Such colonies are great time-savers, and a small log or stone in the water a suitable distance from the shore will soon be used by the voles. A stand camera with roller blind, focal plane, or Luc shutter will be better than a reflex.

The miniature camera worker will readily appreciate that opportunities for successful photography are endless.

Squirrels should be fed before attempting to photograph them. The animals can sometimes be discovered in a semi-tame state in parks where they are encouraged. Feed regularly and entice them away from the vicinity of many branches to one suitable branch, which may be natural or placed by you at a height suitable for photography. A post with a flat top is a favourite sitting place for squirrels, which are never free from fear on the ground. Work from a hide, preferably with a stand camera.

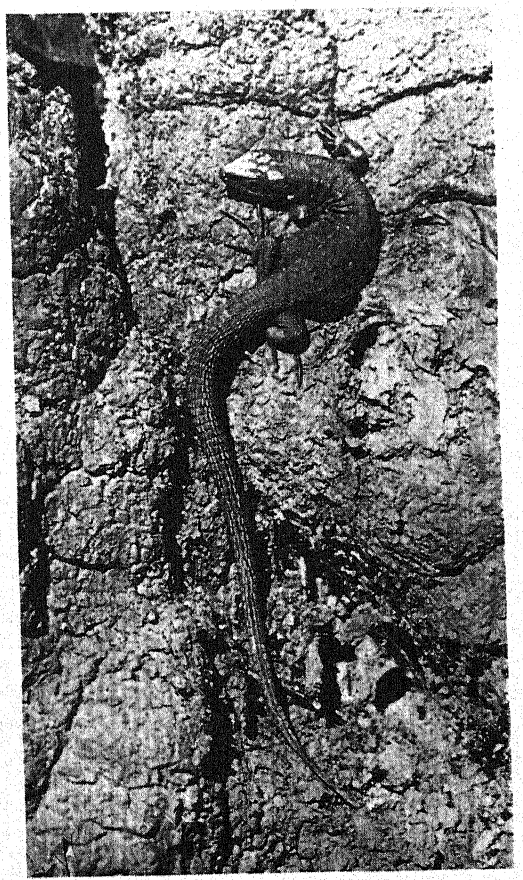
Pictures of Reptiles

Reptiles (snakes, lizards, tortoises and turtles) are best photographed under control. The adder is poisonous and must be handled carefully. All that is necessary to obtain successful photographs is to focus on the ground where you intend to photograph. Two small stones between which the subject will later be placed enable the photographer to be sure that the sitter will be properly registered on the plate. A still reptile is as motionless as if dead; when moving, few shutters indeed can eliminate movement. The photographer must know enough about his subjects to enable him to stop lens down and give a short time exposure. Use a stand camera. The shutter need not be silent.

Snakes and lizards can be photographed wild simply by stalking, setting up camera, and exposing. It is not easy and movements of the photographer must be smooth and unhurried. No shadow must touch the basking reptile.

Amphibians (toads, frogs, newts and salamanders) can be treated the same way as reptiles. They are slower in movement, but more persistent. I spoil more plates with amphibians than with reptiles. Amphibians have an aquatic metamorphosis, so to be complete the photographic series should show newts in breeding dress in water, and tadpoles. This falls under the heading of aquarium photography (*q.v.*).

The study and photography of insects is a subject providing much interest and tremendous scope. Many are easy, *e.g.* butterflies at



LIZARD IN THE SUN. Various reptiles, such as snakes and lizards, can be photographed wild, but in stalking them the photographer must move stealthily, care being taken that no shadows fall on the subject to startle it

Photo, A. R. Thompson, F.L.S.; Cooke f5.6 lens, 2 secs. at f23, Barnet super speed plate

rest after sundown, moths at rest on tree trunks, beetles on flowers, etc. Active ground beetles should first be focussed with a stand camera on the ground under a tin lid with a glass top. When the beetle stops running round, if it is in a good position, lift away the lid and expose. Exposure should be short. Even when otherwise still, insects often wave their antennae about and in this manner spoil plates.

The life-history of insects consists of four stages: the egg or ova, the caterpillar or larva, the chrysalis or pupa, and the perfect insect, or imago. The egg is immobile and offers no difficulty except that it is usually a photo-micrographical subject. In most insects the pupa state is quiescent and photography perfectly straightforward. The imago usually gives little trouble. Everything must be done not to excite an insect. A butterfly out of the sun will usually remain quiet, so will a day-flying moth. The night flyers allow themselves to be photographed in the daytime. Few insects will sit if picked up and put on a particular perch, but most will crawl where wanted if gently persuaded into position. The larvae of insects provide the most difficult subjects. Some are aquatic and must be photographed in tanks, others are subterranean or wood borers and can only be photographed under some form of control and never look very natural.

The leaf feeders make good pictures and can be photographed without spoiling many plates if the photographer will go to a little trouble. The larvae to be photographed should be kept supplied with fresh food-plant. A hungry caterpillar is always restive. In the larva rearer, place several picked sprays of food-plant in small tubes of water. Before long a larva will be seen to be resting quietly on one of the special sprays. The camera is erected with a suitable background, and the twig quietly lifted with the caterpillar, and screwed into the position required.

ANIMAL CINEMATOGRAPHY FOR THE AMATEUR

Making motion pictures of wild life is a pursuit that every amateur should consider, for the inherent qualities of the cine camera make it very suitable for such work

Modern inventions have enabled the amateur photographer to take cinematograph pictures in miniature of moving objects. There are many makes of these small cameras now on the market, and if the photographer cares to go to a little trouble there is no reason why he or she should not obtain some excellent films of our wild birds and mammals.

Animal cinematography is easier than obtaining stills; there is no waiting for the appropriate moment for exposure when the animal is at rest. The more action there is in your subject the better the result will be. Another great advantage is that the photographer need not be so close to his subject. When taking a still photograph of, say, a thrush with a 6-in. lens, the photographer should be within eight feet, but with a sub-standard cine camera and a 6-in. lens the photographer could be 50 feet away and obtain a life-size picture on a 4-ft. screen.

The reason for this is that the actual picture on 9 or 16 mm. is exceedingly small, and when projected on to a screen of four or six feet across, the enlargement is very great



REYNARD ON THE RUN. The fox, with his swiftness and lively action, is a most suitable subject for sub-standard cine-camera work. Above is a cine-frame, enlarged, of a fox caught by the camera as he leaves his lair

Photo, Oliver G. Pike

If we attempted to enlarge a single picture from one of these sub-standard films to the size we show it on the screen, it would be so coarse and grainy that it would be useless as a photograph, but when one picture follows another with great rapidity, this grain is not apparent.



OTTER IN WAITING. The continuous purr of a cine camera is far less likely to frighten animals than is the sudden click of a still camera's shutter. The fine photo of an otter seen above is enlarged from a single frame of standard cine film
Photo, Oliver G. Pike

Alternative Lenses. All the sub-standard cine cameras put out by our best firms are reliable instruments and will turn out the finest work; some have a turret mount that takes several lenses, which is a great advantage, for we can then quickly change our lens to suit the subject. A lens of 4-in. focus would act as a very powerful telephoto lens on a 9-mm. camera. There is a very accurate focussing scale on the lens mount, and the distance from the subject should be measured carefully, so that the exact focus can be obtained. It is a good plan to fit a miniature range-finder to the camera; this will tell you your distances without going to the trouble of measuring.

Many beginners in bird photography make the mistake of working too close to their subject. When attempting to take cine pictures of a bird feeding its young at the nest, you obtain a far better picture if you build your hide 12 feet from the nest than you would if you were trying to do it at a distance of a yard. In the latter case you are so close that there is little possibility of the bird returning, while at 12 feet away you can make a well-camouflaged hide, and your bird will be back quickly.

A Practical Ruse. When working with a hide, always endeavour to have a companion with you to walk away when you are inside. Most birds are able to distinguish between two people going to the hide and only one walking away, but this difficulty can be got over quite easily; the one who walks away carries at arm's-length a long coat with a hat placed on the top. This little ruse has been successful with myself when filming the wildest birds. If you work alone and your subject, be it bird or mammal, sees you enter your hide, you are simply wasting your time, for none but the very tamest creatures will return.

You need not think that the noise made by the cine camera will scare your wild sitters; birds and mammals take no notice of a continuous noise, but the sudden click of the shutter on a still camera will cause them to hurry away in fright. I have filmed at close quarters otters and badgers, mammals with a keen sense of hearing, but the continuous noise of my cine camera has not scared them.

The most difficult part of cine work is obtaining the correct exposure. In a roll of film we may have a dozen or more shots of different subjects, all taken in varying conditions of light. When the negative is developed these cannot be cut out and treated according to their exposure, as the complete roll is developed at once, and all the subjects obtain the same amount of development. If our exposures are not correct, some may be over-exposed and some under. Fortunately this is a difficulty that can be got over with the greatest ease by using one of the numerous photo-electric cell exposure meters now on the market. These tell you the exact stop and exposure to use under all conditions of lighting.

Lengths of Shots. A fault the amateur cinematographer must guard against is exposing long lengths of film on one subject. When taking shots of such subjects as birds in flight, birds feeding their young, or mammals devouring their food, a length of film lasting 15 seconds on the screen is quite enough, since a shot on the same subject lasting a minute becomes monotonous; the interest in a film is far greater if we fill it with variety, instead of showing long lengths of one scene.

Some of the sub-standard cine cameras are fitted with a device for speeding up the exposures; this gives us slow-motion when projected on the screen. I have found that a great many amateurs on acquiring one of the small cine cameras think that to produce slow-motion effects on the screen the pictures must be taken slowly.

If our small camera is geared up so that we can take 60 pictures a second we obtain some beautiful effects in slow motion, but again we must be careful not to waste film by exposing long lengths on one subject. All lenses used on the 9- or 16-mm. camera should be fitted with hoods to keep out extraneous light; the hood also helps us to take pictures against the light, and some very beautiful effects can be obtained. A white bird, such as a seagull which nests on the ground, makes a far better picture taken against the light, for in cinematography shadows always add to the interest. The same bird taken with the light shining directly upon it is not nearly so attractive.

With most wild creatures a hide is necessary; this should always be camouflaged to resemble the surroundings. Hours of waiting can be saved by those photographers who use their wits when building a shelter. The camera should be fixed in position and the hide built over it.

OLIVER G. PIKE, F.R.P.S., F.Z.S.

ANIMATION. Making inanimate objects move, apparently of their own volition; *e.g.*, a plate appears to slither across a table. It is placed on one end of the table and a single exposure (one frame) made on it. The camera is stopped and the plate moved forward a trifle. It is filmed in its new position (the camera being in the same position throughout) and each successive position likewise filmed, the plate being moved slightly between each exposure. In the projection the plate appears to move. Cameras not fitted with a single-picture device should be set at eight frames a second, and the button given a sharp jab. This method of "one turn, one picture" is termed "stop motion" (*q.v.*). It is the basis of cartoon work.

ANTIQUES: HOW TO PHOTOGRAPH THEM

Special methods, as described here, are required in the photography of old furniture, antique glass and *objets d'art*

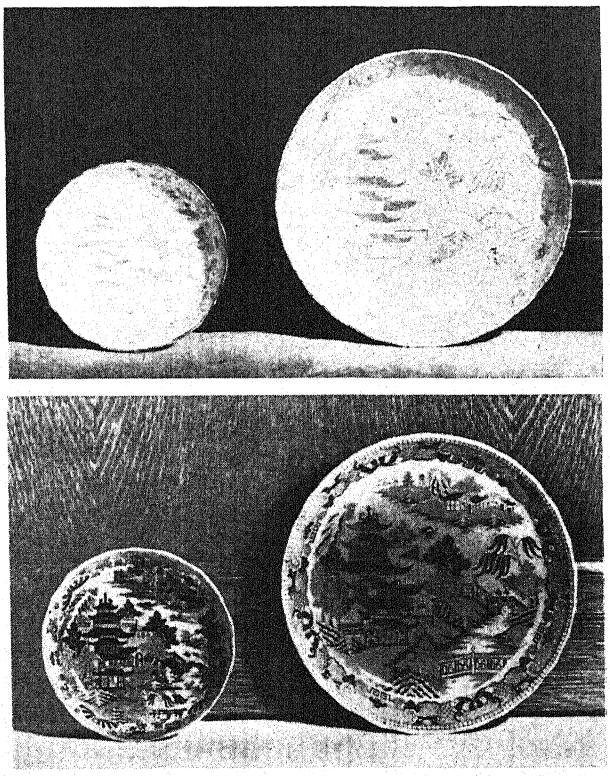
Pleasing pictures of antique objects, such as period furniture, glass, china and the like, may at times be made with an ordinary hand camera, but for serious purposes, and especially for reproduction, it is essential to employ a stand camera having a long extension in order that long-focus lenses may be used with it. The longest focus lens available should be employed in photographing articles of antique



PERIOD PIECES. Two examples of antique objects photographed on a perfectly white background for reproduction purposes. Left, Dutch spinning-wheel; right, chair of Cromwellian period
Photos, J. F. Stirling

interest, for the longer the focus of the lens the farther away the camera may be placed from the object, and the better the " drawing " or perspective of the object in the photograph.

Although an antique " piece," such as a table, a chair, a grandfather clock or an old oak dresser, may have a more " natural " appearance when photographed in its customary situation, it is the practice of catalogue compilers and of editors of periodicals devoted to the study of antiques to demand photographs of antique furniture possessing plain and preferably white backgrounds. To take such photographs the article of furniture must stand upon a white sheet which should be extended vertically at the back of it. If the vertical portion of the sheet and, as far as possible, that upon which the object is standing are kept moving during the period of exposure, a perfectly plain background will be obtained in the negative.



FALSE AND TRUE. Above is a photograph of willow-pattern dishes against a wooden panel background taken on an ordinary plate. Below, the same articles have been photographed through a red colour filter on a panchromatic plate. The improved rendering of detail is very striking

Photos, J. F. Stirling

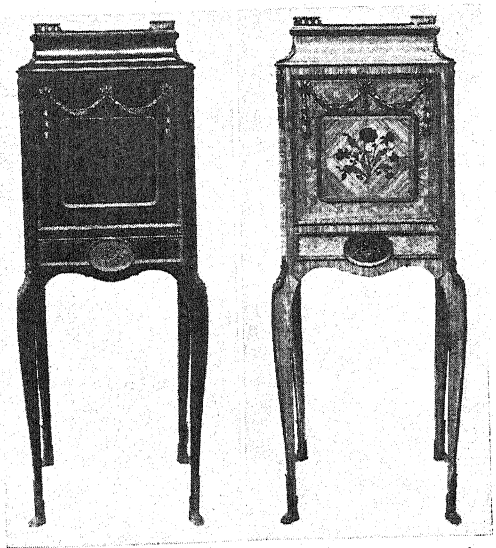
Much of the success of antiques photography depends upon the angle from which the photograph is taken and, also, upon the lighting. Generally speaking, an object of antique interest should never be taken " straight on." It is better to take the photograph from an angle and to have the light bearing obliquely on the object. The surface texture of the object is thereby emphasized, irregularities clearly displayed and troublesome reflections frequently reduced to a minimum.

Panchromatic plates or films are not essential for the photography of old furniture, but they are often advisable, especially when they are used in conjunction with yellow, orange or red colour filters, in order to render maximum detail in the wood surface. Antique furniture which is reddish in hue—as, for instance, mahogany—and that which is brown-red varnished should always be photographed on panchromatic emulsions, otherwise it will appear almost perfectly black and lacking in detail in the finished photograph.

The photography of articles of glass, pottery and metalware is not difficult provided, in the main, that the correct lighting conditions are obtained and that unwanted reflections are avoided. Glass, china and similar ware must be photographed against a black or grey background, and, particularly in the case of glassware, great care must be taken to reduce annoying reflections to a minimum. This can be done by employing as diffused a light as possible and by holding up in front of the camera a black cloth in which a hole has been cut for the camera lens.

It is not usually advisable to endeavour to eliminate completely reflections from a glass, metal or pottery article which is to be photographed, for a judicious amount of reflection on the article adds to the natural effect of the photograph and imparts to it an additional " roundness."

It is sometimes recommended to wipe bright metal articles over with a rag charged with metal polish before they are



CONTRASTING RESULTS. Two examples showing how right and wrong materials can make or mar a photograph of furniture. Left, picture taken with ordinary plate. Right, details of design brought out to the full by panchromatic plate
Photo, Ilford, Ltd.

photographed. This certainly reduces the reflections, but unless the metal polish is very evenly applied a patchy result is obtained. Vessels of silver and other metals which are to be photographed may have their bright surfaces dulled by the simple expedient of filling them with very cold water.

Glass tumblers, vases and similar articles are best filled to the brim with water to which a few drops of potassium permanganate solution (sufficient to colour the water faintly pink) have been added.

Sometimes an object of glassware will have a pattern delicately engraved or etched upon it. This can be brought up clearly by rubbing a little talcum powder over the glass surface and then blowing the surplus away.

For accentuating the designs and patterns upon china and pottery articles, recourse must be made to the use of colour filters.

For serious work in antiques photography artificial lighting is the best to use, and the beginner may obtain excellent results by employing a couple of photoflood lamps. Backed plates (if films are not used) are essential and full exposures must be given.

APERTURE. The aperture of a lens is that area of its glass which is unobscured by the stop or diaphragm. Upon the size of the lens aperture depends the amount of light admitted into the camera.

Since the area of a circle is proportional to the square of its diameter, it follows that the amount of light transmitted by a lens must also be proportional to the square of its aperture diameter.

Suppose, for instance, that we take an 8-inch focus lens having an aperture of 1 inch in diameter and we find that, with a certain intensity of light, we can make a crisply defined picture with one second's exposure. Bearing in mind the law enunciated in the previous paragraph, it will become evident that, given a lens of similar focal-length but having an aperture of only half an inch diameter, the necessary exposure under the same conditions of lighting would be not two but four seconds.

We may say, therefore, that the difference in exposure times necessitated by the use of different lens apertures is as the squares of the diameters of the latter.

This assumes, of course, that the area of the lens aperture is the same as the actual area of the opening formed by the stop or diaphragm. When the diaphragm is placed in front of the lens these values are equal. In many lenses, however, the diaphragm is situated between the lens components, and under these conditions the diameter of the shaft of light passing through the lens may be greater than the diameter of the lens aperture, since the front component of the lens acts as a condenser and converges or narrows down the light beam so that a beam larger than that actually transmitted by the front component could pass through the diaphragm aperture. The diameter of this beam represents the *effective* or *working* aperture of the lens in contradistinction to its actual aperture.

What is known as the " focal aperture " of a lens is simply its effective or working aperture expressed numerically as a fraction of its focal length. Thus, if a lens of $4\frac{1}{2}$ inch focal length has an effective aperture of 1 inch diameter, its focal aperture will be represented by the expression $\frac{1}{4.5}$ or, more usually by $f4.5$. All these "f numbers," which frequently puzzle the beginner, merely express the ratio of the effective aperture of the lens to its focal length.

See also Depth of Focus; Diaphragm; Focal Length, Lens.

AQUARIUM PHOTOGRAPHY: THE BEST METHODS

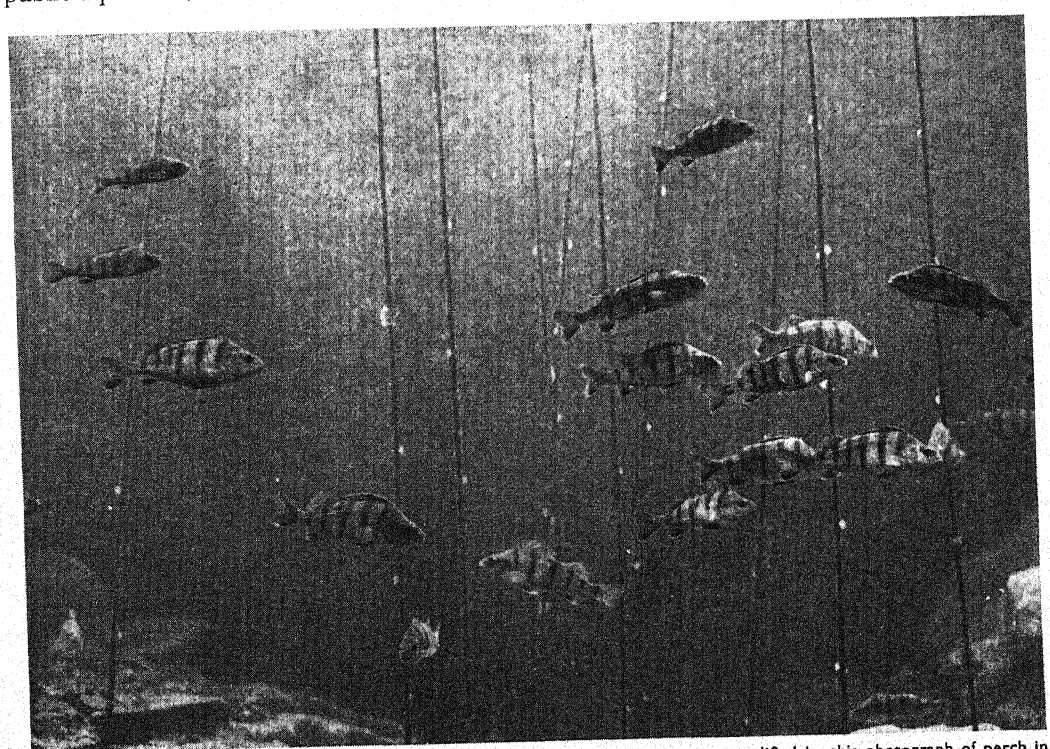
Bernard Alfieri, Jr.

Under-water creatures form a fascinating subject for the animal photographer, and with modern equipment and material it is possible to obtain first-class pictures through glass and water. This article, aided by instructive illustrations, clearly explains how satisfactory results can be obtained by the intelligent use of artificial light and other means

PHOTOGRAPHING fish, either in a small tank or pond at home or in a large public aquarium, is a fascinating pursuit, but owing to the difficulty of arranging the lighting to combat diffusion in the water and reflection from the sides of the tank, the making of satisfactory pictures is not as easy as might at first sight appear, and some special apparatus is needed.

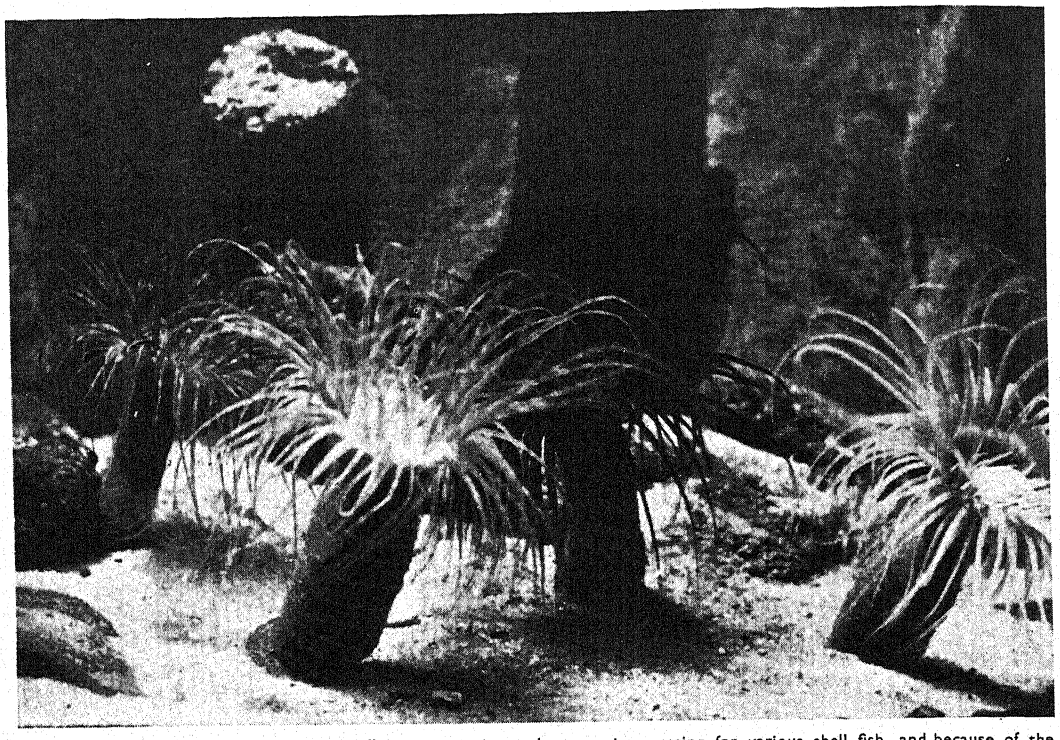
Aquarium photography is conveniently divided into two main classes: first, using a camera on small tanks in the home which can be arranged and lighted to suit the particular requirements of the subject, and, second, photographing through the glass of big tanks such as those at a zoo or public aquarium, where little can be actually arranged and it is a question of making the most of existing conditions.

In dealing with the latter, most aquariums offer the minimum possible amount of light. Bright light would trouble the fish, and in many cases the tanks are viewed by the public from a hall in almost complete darkness. The illuminated tanks, which appear to be brilliantly lit in contrast, are often only illuminated by a single 60-watt lamp from above. This light after diffusion through the water is hopeless for rapid exposures, and if moving fish are to be photographed additional lighting arrangements are essential. The easiest method is to employ synchronized flashlight; a large-size flash-bulb is sufficient at close quarters,



PERCH IN COMPANY. Fish moving in shoals can make an attractive picture, as exemplified by this photograph of perch in which the subtle tones of the background contrast well with the striped sides

Photo, F. W. Bond, F.R.P.S.; f4.5, 1/10 sec.

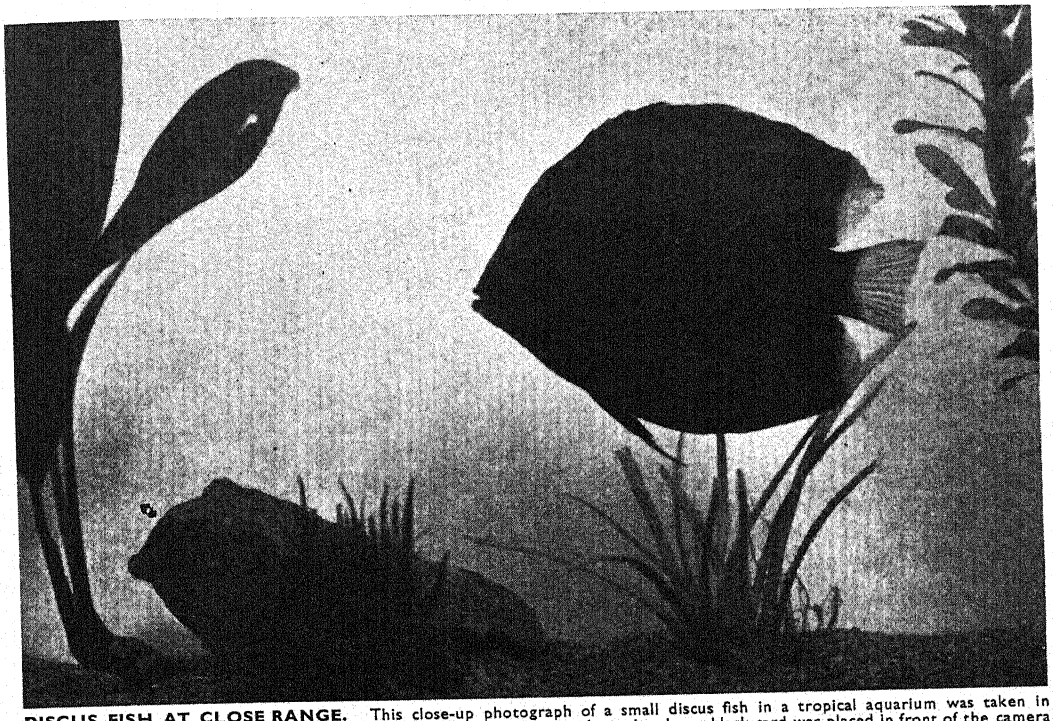


UNDER-WATER LIFE. Sea anemones offer an attractive and appropriate setting for various shell fish, and because of the slowness of movement long exposures can be given. The lighting used in this photograph was by daylight bulbs, and the exposure was 30 sec. at *f*6.3



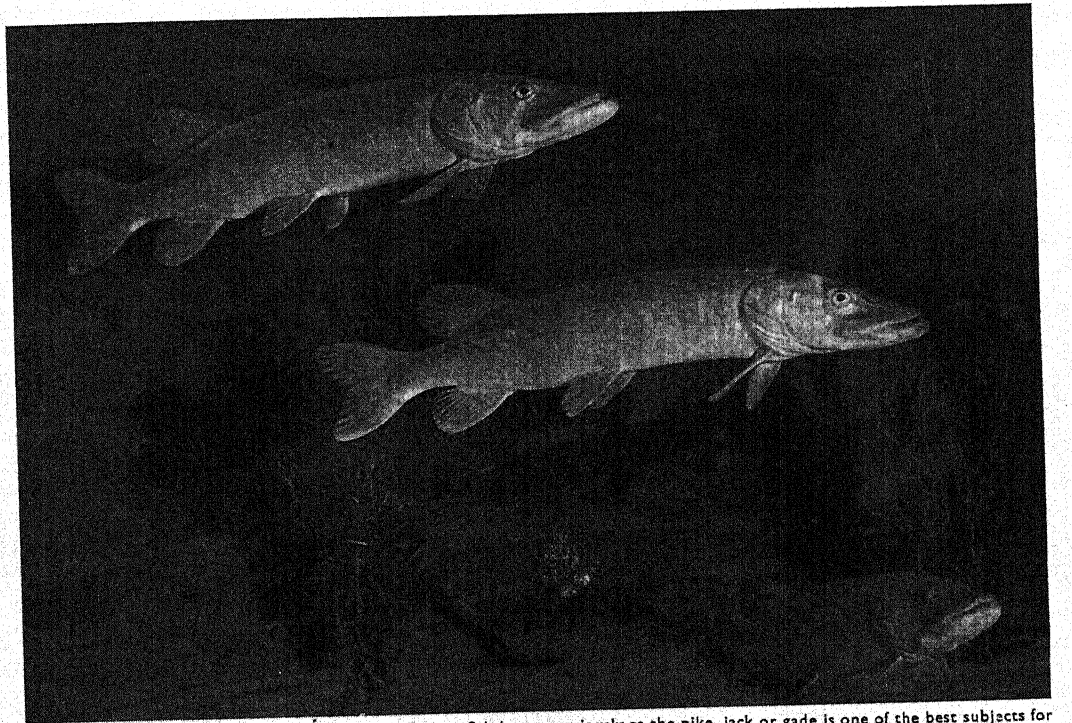
SCORPION FISH AT THE LONDON ZOO. By careful observation of their habits it is possible to estimate when certain fish will remain motionless for short periods. It is then that the best opportunities occur for taking photographs This picture of two scorpion fish was taken with a Leica (miniature) camera by normal lighting at close range with a 10-sec. exposure at *f*4

Photos, Bernard Alfieri, Jr.



DISCUS FISH AT CLOSE RANGE. This close-up photograph of a small discus fish in a tropical aquarium was taken in bright daylight and at close range. In order to eliminate reflection from the glass a black card was placed in front of the camera with a hole for the lens (see text)

Photo, Bernard Alfieri, Jr.; f2, 1/20 sec.



TRIO OF SUITABLE SUBJECTS. The freshwater fish known variously as the pike, jack or gade is one of the best subjects for the photographer engaged in taking under-water photographs, since it has a pronounced habit of remaining motionless for considerable periods. These three "ruminant" fish were photographed in the London Zoo

Photo, F. W. Bond, F.R.P.S.; with Sashalite, f4.5, 1/50 sec., Ilford hypersensitive plate



FOXES AT THEIR "EARTH" Oliver G. Pike, F.R.P.S.

"Birdland" Camera (9-in. lens), 1/50 sec., f8; taken early on a June morning (see article on Animal Photography, pp. 75-88)

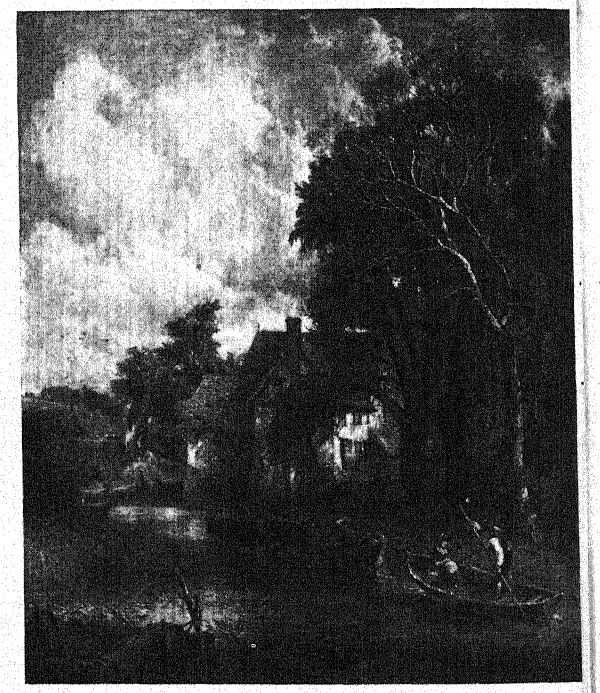


BATHING GIRL

Cecil D. Notley

Leica, 9-cm. lens, 1/100 sec., f4, Agfa F pan. film





LOTT'S COTTAGE, FLATFORD. Above is a photograph of this famous beauty spot by L. A. B. Edenborough (Zeiss Ikon Trona, Tessar *f*4.5 lens at *f*5.6, 1/30 sec., Ilford soft gradation pan. plate). On right, the cottage as it appears in Constable's well-known painting "The Valley Farm."

(See Mr. Wastell's article on Art in Photography, pp. 114–117)

Unfortunately, most cameras fitted for synchronized flash-bulbs carry the battery and lamp as an integral whole on the camera itself, offering a front light which is almost certain to reflect on the glass of the tank; but it is a fairly simple matter either to place the lamp unit on a separate stand, or hold it as far to one side as possible, connecting the apparatus with flex.

Where arrangements can be made to use flood or photoflood lamps, much more can be done by way of avoiding reflections and achieving good lighting effects. The lighting units should be placed at an oblique angle to the glass each side of the camera, and if predominance is given to one over the other the lighting will offer good modelling and roundness to the subject.

In page 94 is an example where two scorpion fish settled in one position and remained there nearly 30 seconds, during which period a miniature camera was quickly focussed at close range, and an exposure of 10 seconds was given at *f*4 by the existing light in the tank.

Anemones and certain shell fish in a setting of marine plants offer attractive studies where long exposures can be given. An example is seen in page 94 (top), where an exposure of 30 seconds was given at *f*6.3, and shows little movement. In this case the tank had been lit by daylight bulbs, giving the appearance of very actinic light from the darkness in front of the tank, just another pitfall for the photographer. The so-called daylight bulb cuts out an excess of yellow and red, which from the point of view of exposure provides less light than a similar bulb with a clear glass.

Methods with Home Aquaria

When photographing the home aquarium, arrangements can be made to obtain the pictures under ideal conditions. Portraits of small individual fish can be conveniently exposed by narrowing the width of the "studio." A small tank is provided with a piece of glass that can be inserted near the front, as in Fig. 1 (p. 102), the background of weeds and the usual setting of the tank being arranged in the larger compartment. For the purpose of illustration the camera is shown too close to the tank, but with a long extension, or suitable close-up attachment, the subject can be photographed as large as possible on the negative. At the last moment the fish is placed in the front compartment, where its movements are confined within an easy depth of focus for the camera. A picture of angel fish (p. 97) was exposed in this manner in bright daylight, with an exposure of 1/20 sec. at *f*4.5. A white card was placed at the back of the tank, as shown in Fig. 2. Light-coloured fish often stand out better against a dark background, when a black card can be substituted as may be required.

The background card should be out of focus, and the brightness in daylight can be controlled by arranging the card in shadow, or altering the angle to catch or miss any direct light. Reflection on the glass of the tank must be avoided, or a portrait of the camera and photographer will probably be included in the picture.

Eliminating Reflections and Shadows

Under certain lighting conditions it is advisable to cut a hole in a piece of black card and stand this up in front of the tank, allowing the camera lens to point through the hole, care being taken not to let any shadow from the card fall across the tank. A small discus fish in a tropical aquarium was taken by this method (p. 95, top). This photograph, taken with a miniature camera very near to the tank, shows a small fish about an inch in length and practically black in colour.

When employing artificial light the same precautions are required as on larger tanks. The lamps should be placed well to the side, as shown in Fig. 3 (p. 102), one lamp being slightly nearer than the other. On small tanks, where the lamps are near to the subject, very short exposures can be given, but on no account should the light be used for long periods, or the fish will be seriously troubled and difficulty will be experienced in posing the "sitter."

Very effective pictures are often taken from above. A simple arrangement is shown in Fig. 4, where the camera, on two pieces of wood, for the sake of clearness is again shown too near to the tank. The light can be arranged from the sides, as shown in this photograph, or the lamps can be fixed on the wooden strips at each side of the

camera; and, naturally, in either method the precautions against reflections already dealt with must be observed.

Much of the beauty of fish life is dependent on colour, and particularly in tropical aquariums very bright reds and yellows are to be found, apart from the subtle tones of green in the weeds and background effects in many varying subdued hues.

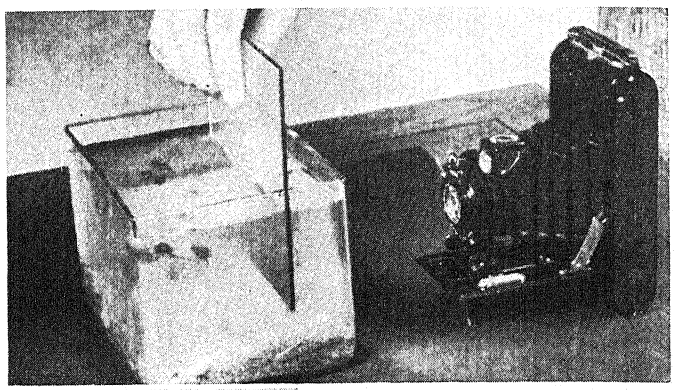


Fig. 1. The movement of the fish to be photographed can be restricted by inserting a piece of glass in the tank to form a separate small compartment

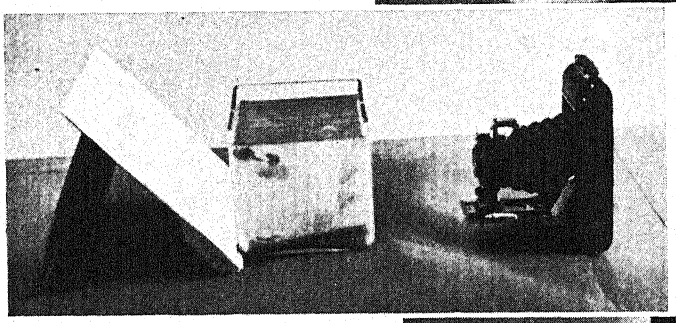


Fig. 2. Showing the position for a background. The colour or shade of the card can be varied to suit the subject

For this reason panchromatic plates or films are to be recommended, and as there is little difficulty in obtaining sufficient subject contrast, very fast emulsions are to be preferred.

When using a miniature camera on small aquariums the subject should be as large as possible on the negative, in order to give the best chance of enlargement with the minimum amount of grain. A long focus lens is often an advantage, and some form of near focussing attachment will bring very small fish within the range

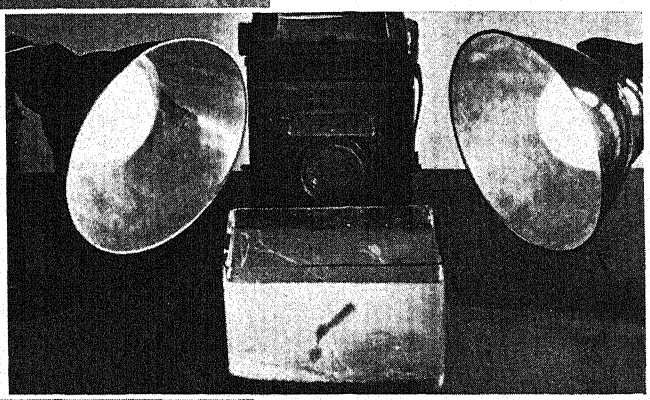


Fig. 3. When using artificial light, the lamps should be located well to the side of the tank, one being slightly ahead of the other

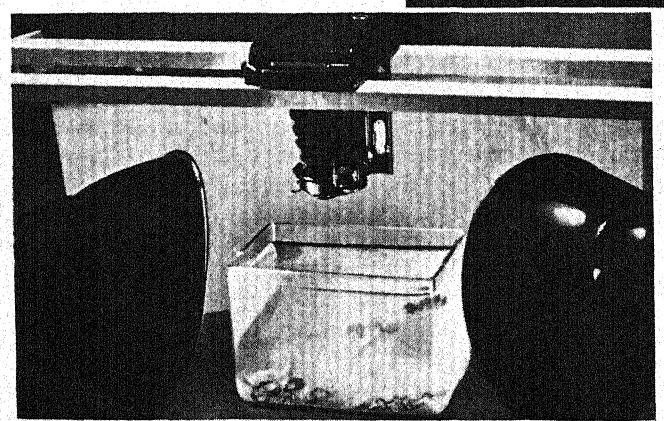


Fig. 4. How the camera can be arranged on two wooden supports above the tank for taking vertical photographs

Photos, Bernard Alfieri, Jr.

of the camera. For most aquarium work in the home a long extension is essential on the camera, to allow the apparatus to be placed close to the tank; and whilst excellent aquarium photographs can be obtained with almost any camera, there is an additional pleasure in the knowledge that ingenuity in adapting and applying standard equipment will be rewarded by a larger field of operation and better pictures.

ARCHAEOLOGICAL PHOTOGRAPHY IN FIELD & STUDIO

D. S. Lyon

Of the British Museum Photographic Studio

In a previous article (Aerial Photography) the value to the archaeologist of the camera when used in conjunction with the aeroplane is made clear. Here we are concerned with the technique of photographing relics of the past at close quarters both in the field and in the studio

ARCHAEOLOGY has in photography a vital and indispensable ally, for without the camera countless objects of the past that have been unearthed could never have been fully studied and understood.

The archaeologist, working on a site, uncovers some relic of a past age. Time has rendered it so frail that at a touch it would fall to pieces, even crumble to dust. But the camera is brought into action and a lasting record is made before the object is lost for ever. Again, an object is broken on being removed from the site, but by means of photographs taken previously the scientist has a sure guide in reconstructing his find. Figures, marks and shapes dimly discernible on some ancient piece are brought out brilliantly, too, in a skilfully-made photograph so that the expert can study them minutely to trace their meaning and their origin. Excellent examples of work of this kind may be found in Sir Leonard Woolley's book " Digging Up the Past " (1930).

Work on the Site

The archaeologist uses his cameras both in the field and in the studio. For use in the field a large number of workers prefer a miniature camera, such as the Leica, and in many instances, particularly where space is restricted, it has obvious advantages. Alternatively, stand cameras are frequently employed—usually of the half-plate size. With the apparatus rigidly set up, a series of photographs can be made from precisely the same viewpoint, so that a double check can be obtained as the work of unearthing some relic slowly proceeds.

So far as the latter type of camera is concerned, it may be said that any make is suitable provided it is equipped with an anastigmat lens, which gives the most uniform definition and a complete flatness of field—two features that are highly important in archaeological work. Another desirable feature is that the camera should have a good falling front.

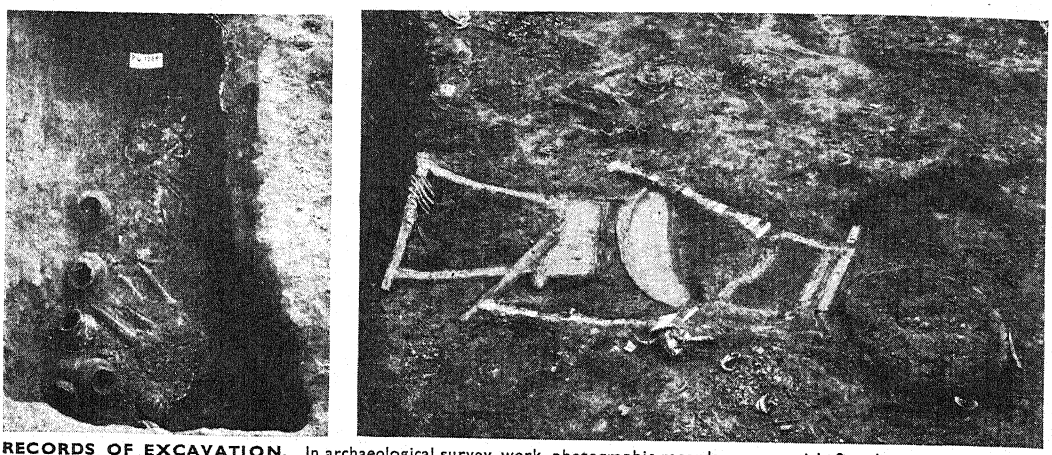
As a general rule the plates used should be of the fairly fast orthochromatic grade of a speed about 400 H. & D. There are occasions when a negative and print are required in the shortest possible time, and for this reason a temporary dark room is erected on the site of operations. For developing the plates under these conditions metol hydroquinone is to be recommended.

Studio Methods and Research

The more intricate though very interesting work of the archaeological photographer undoubtedly lies in the studio. He leaves the site of operations with his finds carefully packed, and sets them up ready for photographing. There is then no need for compromise in lighting and exposure, and all can be meticulously prepared and thoroughly carried out. In studio work the writer uses a good square bellows camera with an anastigmat lens, and since the lighting is controllable, plates of varied type can be used with success. In many instances the lighting is all important. Incorrect location of the lamps will result in the image appearing flat and lifeless, whereas judicious application of a top front light or a side light will have the opposite effect.

For most subjects panchromatic plates or films in conjunction with a filter produce the best results, but orthochromatic and infra-red material are frequently used. Panchromatic plates with a speed of about 400 H. & D. are fast enough, and even when prolonged development is necessary, to give extra contrast, they show no tendency to fog.

This lengthy development is usually necessary when making pictures of such objects as painted pottery, in which a red design may be superimposed on a brownish-coloured base. If the colours are not excessively faded, then a panchromatic plate



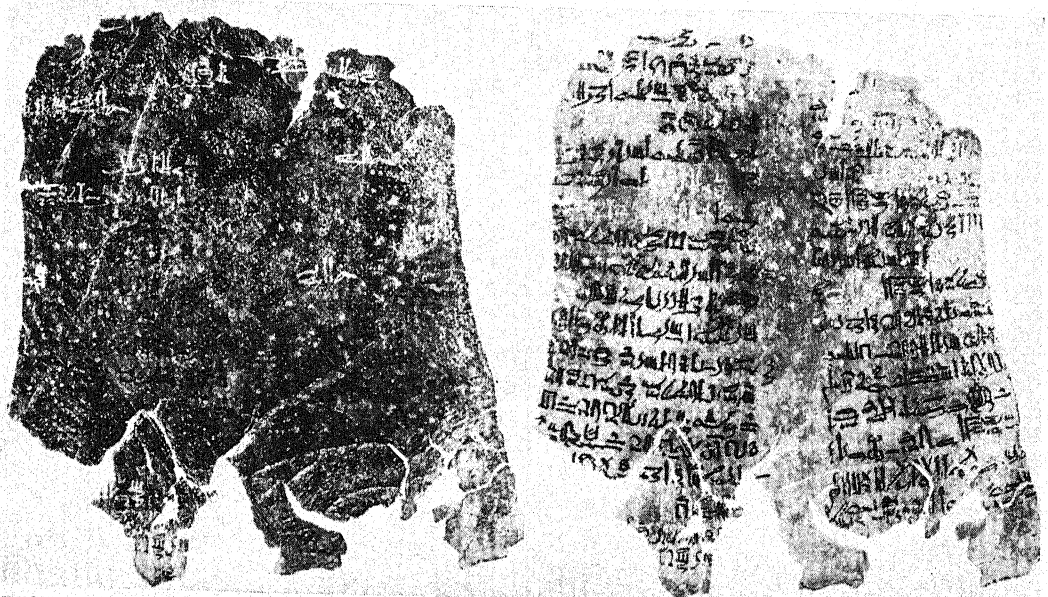
RECORDS OF EXCAVATION. In archaeological survey work, photographic records are essential, first because, after having been buried for centuries, many precious objects are liable to crumble to pieces when handled, and, secondly, because the position in which they are found may provide valuable information as to the social customs of the period

Photos, Joint Expedition to Ur

and a pale filter can be used to good effect ; on the other hand, should the colours and design be dull and obscure, orthochromatic material is more satisfactory.

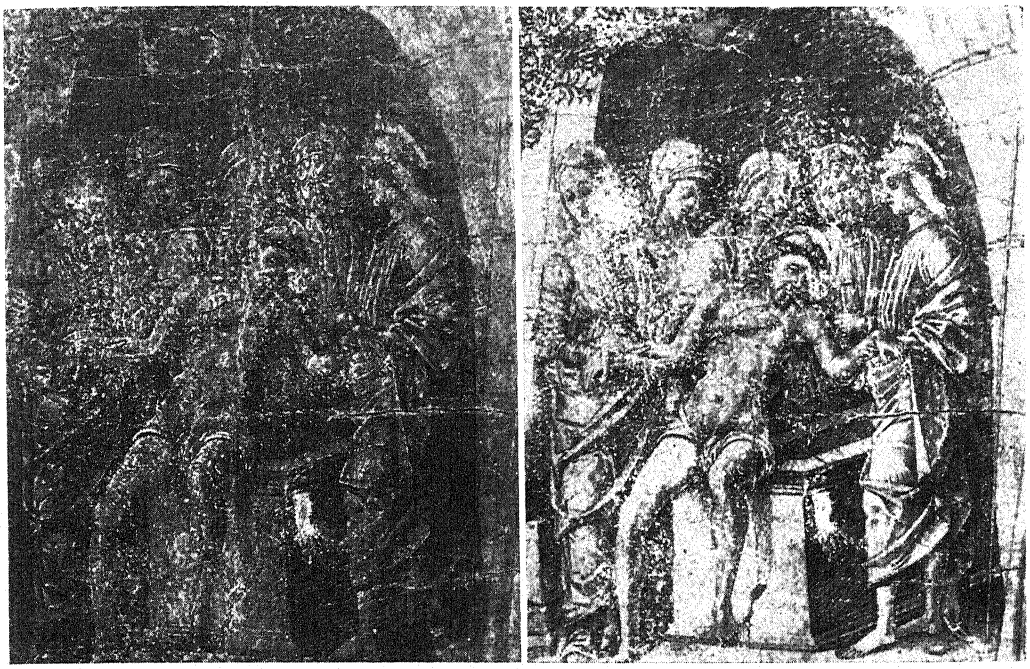
In the case of objects of extreme antiquity which have become nearly black with age, disappointing results often occur even when panchromatic material and red filters are used. It is then that one can successfully resort to infra-red. Some very old portions of leather—exhibits in the British Museum—were photographed by various means. These exhibits bore pieces of text, the letters being written in red and black. To the eye the text was just distinguishable but completely unreadable, and photography was utilized in an attempt to trace the words.

In the first place a panchromatic plate with a red filter was tried, and while those letters that were written in red were made clearer in the negative, the black portions of the text were still unreadable. It was then that infra-red plates with a suitable filter were used. The results were surprising ; the



DECIPHERED BY INFRA-RED. This old fragment of leather, bearing a text in red and black, was first photographed on a panchromatic plate with red filter. The result, left, shows that only part of the inscription was made legible. By employing infra-red material, the remainder of the text was clearly revealed (right)

Photo. British Museum



REVEALING HIDDEN BEAUTIES. Even by using a panchromatic plate and filter it is not always possible to bring out the details of an old and discoloured print or painting such as that on the left. With infra-red material, however, much hidden detail is revealed, as shown by the photograph on the right. *(Photos by permission of the Trustees of the British Museum)*

whole of the black text appeared in the photograph as clearly as when it was first written, and it was made plain to experts that the date of the relic was about 1200 B.C. and that it was of early Egyptian origin.

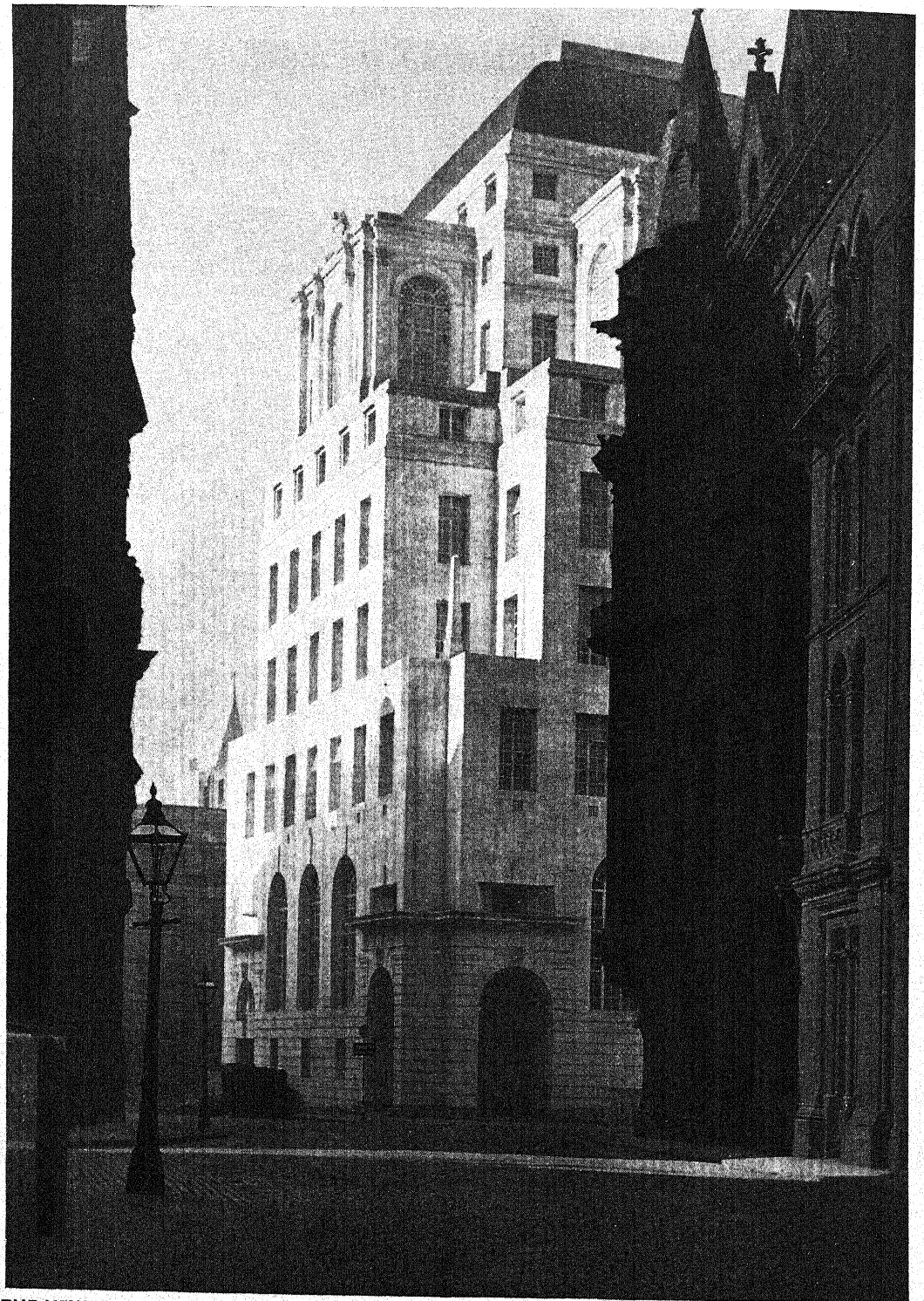
Another example may be given. A very old drawing which was so discoloured that all detail was lost had been photographed with only partial success by using a panchromatic plate and filter. A second photograph was then taken by the writer, infra-red material being used. Without any difficulty, all the detail that had been hidden for years by the discoloration was shown up, and a remarkable photographic record secured.

For the amateur in archaeological photography the infra-red process has a very considerable fascination, especially when the subject is such that infra-red is the only possible medium likely to produce satisfactory results. Moreover, this process requires little in the way of special equipment, and the cost is reasonable. Plates cost only a fraction more than do the panchromatic variety and, except for the addition of a special filter, a perfectly normal plate camera can be employed.

Remember, however, since infra-red rays are capable of passing through certain forms of wood, the plates should be placed in metal slides in order to obviate risk of fogging.

In spite of the fact that the filter is very dense, the exposure is comparatively short. Thus, when the lighting is provided by two 500 half-watt gas-filled lamps the exposure is approximately two minutes with stop *f*22. With daylight the exposure is, naturally, longer. In developing the plates it is essential that there is complete darkness, unless an infra-red safelight is used. As to the most satisfactory developer for infra-red plates, some workers prefer pyro soda, but the writer finds metol hydroquinone perfectly suitable. Prior to placing them in the developer, it is a sound policy to rinse the plates in cold water, as a safeguard against the possibility of pinholes. For prints of archaeological subjects, bromide paper has much to recommend it. Being rich in tone values, it gives good soft results with plenty of detail in the shadows. The developer can be either amidol or metol hydroquinone.

For information concerning the infra-red photography, *see* the special article on that subject.



THE NEW MANCHESTER. This view of the magnificent new building of the Midland Bank, Manchester, was taken on a Zeiss Ikon Ideal camera. Contrast in building style is linked with that of light and shade to give an added significance to the study

Photo, B. R. Fishwick; Tessar f4.5 lens at f11, ½ sec., s.g. pan. plate

ARCHITECTURAL PHOTOGRAPHY: THE MAIN FACTORS

David Charles, F.R.P.S.

The photography of buildings is a distinct branch of the art of picture-making, and since it has its own characteristic problems and difficulties the technique required is specialized. Here the different aspects are discussed at length with much practical advice to show both the scope and limitations of architectural photography

See *also Perspective ; Rising-Front ; Swing-Back*

ARCHITECTURAL photography—that is, the photography of buildings—may be approached from two rather different aspects. A building may appear beautiful for its own sake, or it may achieve beauty by reason of its setting, in which may be included the lighting effect which happens to be there upon it, or for which the enthusiast waits. In short, architecture may be photographed because it provides suitable material for picture-making.

Pictorial or Technical ?

The other aspect is that of photographing architecture because of a more technical interest in that subject, or for an entirely commercial reason. There is no reason at all why the photographer should not treat his subjects as pictorially as he can. The difference is simply that if the subject is not entirely " photogenic " in itself, in its setting, or in the ease of access to it, the picture maker merely rejects it, while the technical or commercial photographer may not do so. He must employ means to overcome the pictorially unfavourable circumstances.

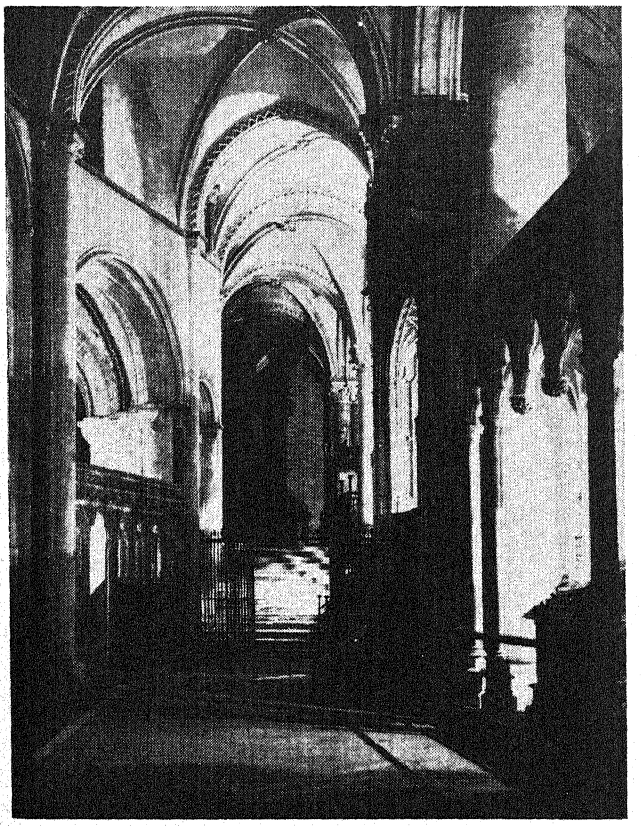
Omitting special applications, as photographs made for purposes of legal evidence, it may be assumed that the approach towards the subject is similar in both types of worker, but that the second may have to take to extremes those points of procedure which are peculiar to architectural subjects, as regards both his craftsmanship and his selection of equipment.

There are few ordinary photographic faults more objectionable than that which makes a building appear feebly to emulate the famous leaning tower of Pisa. Many people like, and few object to, an angle shot which is made deliberately and which successfully conveys the illusion of looking up or looking down, as the case may be, at the subject. It is equally true that a building which is isolated in an expanse of clouds or of trees may not show noticeably a slight lack of uprightness in its vertical lines. But as a general rule lines which are perpendicular in the subject should be truly perpendicular in the print—that is to say, they should be perfectly parallel with the trimmed sides of the latter. If, and only if, the camera back is truly upright at the time of taking the photograph, they will be. Proper use of a spirit-level makes this condition easy to achieve.

For use on a hand camera there is the small circular level, which is fairly satisfactory, and is safe when uprights do not come to the sides of the picture. In other cases it is preferable to employ a tripod, and to use a cross-level in the following manner : Have one tripod leg pointing directly forward or directly backward. First hold the cross-level against the side of the camera, and gently move that leg sideways until the bubble is centred. Then place the level against the camera back (its tube pointing the same way as the lens) and slide the same tripod leg gently forward or back to centre the bubble. This operation takes only a few seconds, and is certain provided the two movements are done in that order.

After-Correction of Verticals

Slight departure from perpendicularity in verticals can be " corrected " by the use of a tilting easel in the process of printing by projection in an enlarger. It is nearly always far more troublesome to do this than to prevent the error as described, and invariably results in the image being taller in the result. If the original error is more than slight, the increase of apparent height in the building may be absurd. Notwithstanding methods for correcting " convergent verticals " which have appeared intermittently in the photographic press and which appear invariably to be based upon mathematical calculations only, the writer has never succeeded in " correcting " convergent



CANTERBURY AISLE AT NIGHT. Beautiful lighting effects on steps and ceiling contrasted with the cloistral darkness of the foreground, are captured in this 2½-min. exposure of the North Choir Aisle, looking East, of Canterbury Cathedral

Photo, W. E. Tattersall; f11, Kodak s.s. pan.

verticals without appreciable distortion, nor has he ever seen a subject truly corrected. On the other hand, there seems no reason why the increase of height to an architectural subject when "corrected" in this fashion should not be purposely employed to pictorial advantage in some cases.

Rising Front

A camera which is properly levelled "sees" only an eye-level picture, *i.e.* one in which detail at level of the eye occupies a central position. But most architectural subjects lie mainly above eye-level. Sometimes one may be fortunate enough to secure a viewpoint opposite the centre of the subject, as from an upstair window. This is particularly useful to note for subjects across which traffic passes, for even bus-tops can sometimes be got just out of range this way. Of course, the perspective of the subject will then not appear as it does from the more familiar aspect of ground-level.

In order to include more of the upper portion of the subject, and less of the foreground, than an eye-level camera provides, the lens is raised on the camera by means of the "rising-front" movement (*see* Rising Front). A hand camera seldom possesses sufficient "rise" to be of real service to the serious architectural worker. The field camera, or one of the hand-stand type, not only has this movement built-in but usually has other features which enable the rise to be still further increased for such emergencies as tall subjects in narrow streets.

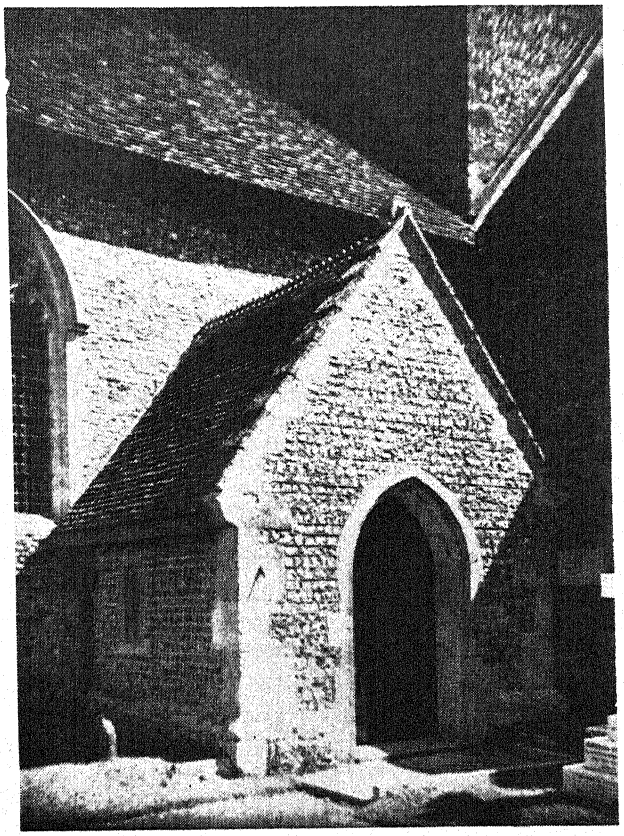
Some architectural subjects lie mainly below eye-level, such as fireplaces, and others are seen better when looked down on, such as tombs and the like. In order to photograph these from a viewpoint above their centres, and still retain proper rendering of perpendiculars, one employs a proceeding diametrically opposite to the foregoing, namely a falling-front, or drop-lens, movement. This is seldom obtainable in sufficient degree without some knowledgeable adjustment of the camera, but can be obtained in various ways by the exercise of a little ingenuity.

Swing Back and Front

The to-and-fro swing of the field camera-back should never be used excepting to adjust the back to truly vertical, as when the base-board is tilted. A side-swing, on the other hand, is extremely useful when the principal plane of the subject recedes. The nearest and the farthest points can be sharply focussed by means of the back side-swing which produces in effect a longer and shorter extension on the corresponding sides of the camera. The whole of such a receding plane, be it a façade or a whole street, can be sharply reproduced without stopping down the lens. The advantage on a dull day or with traffic present is easily realized.

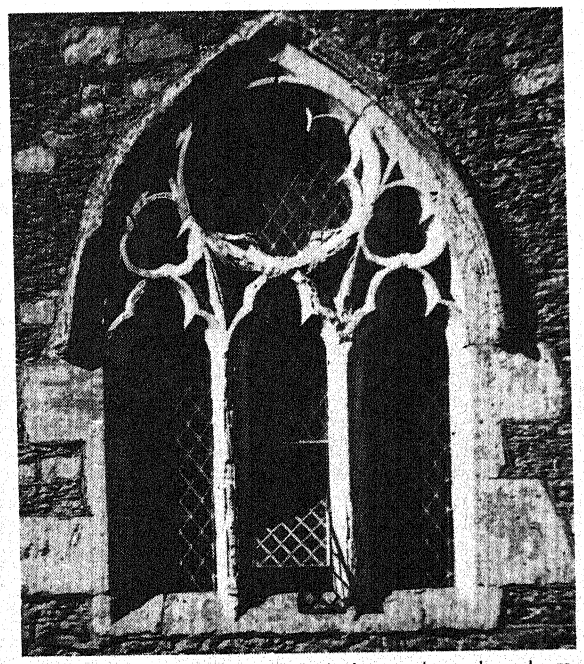
In somewhat similar fashion a slight forward swing to the front of the camera bearing the lens enables one to secure sharp focus at open stop on a flat or inclined plane extending from below the lens to extreme distance; this can be done without disturbing the camera-back or the verticality of buildings, but the upper portions of near ones will suffer severely in definition. The advantage lies in such subjects as possess extensive but interesting foregrounds which call for good definition. These may range from flower-gardens lying before a mansion to roadways on which skid-marks or other texture must be clearly defined, and to interiors in which the flagstones or details of carpets or of furniture are of importance.

It should be borne in mind always that employment of any of these "swing movements" must necessarily increase the acuteness of the perspective, and so exaggerate the apparent distances. Provided that the lens is of suitable character, there is no reason why several of these movements should not be used in combination when the nature of the subject demands. Frequently it is best to effect a compromise between partial use of the "movements" and moderate stopping-down of the lens to secure complete depth of definition without distorting the perspective.



PERSPECTIVE AND VERTICALS. Light and shade contrasted are not the only fine features of this architectural photograph, in which the rhythm of the perspective lines of and above the porch of Alfriston Church, Sussex, add a special attractiveness to the clarity of the picture

Photos, F. Read; Zeiss Ikon Trona, f11, 1/10 sec.



WINDOW DETAIL. Architectural photography need not be restricted to angle shots and wide pictorial effects; a detail well photographed, as this mullioned window is, has a value of its own

The average architectural worker may be inclined to smile at such detailed description of the use of facilities which he neither requires nor in most cases possesses, but there are, nevertheless, many for whom these methods obtain results not otherwise possible. Besides problems of traffic, which prohibit small lens apertures even in wide-angle work, there are old and venerable inns whose signs

swing with the wind, interiors through which other people are continually passing, gardens in which plants wave in the breeze or birds move about. The man who indulges in the use of strong filters, or who desires to make colour photographs of such subjects, knows full well the advantages of any means for securing sharp definition through many distances without having substantially to reduce his lens aperture.

The modern large-aperture anastigmat is seldom the best lens for architecture, simply because in providing maximum "speed" its covering-power extends but little beyond the margins of the size it is designed for. When raised above the centre of the picture, therefore, the corners at the top of it (bottom corners in the camera) may be blurred or even blank. Some lenses of maximum *f*4.5 aperture do possess considerable extra covering power; but those which do have most of this quality, together with the additional desideratum for this work of flatness of field, are undoubtedly found among anastigmat lenses with maximum apertures of *f*6.8 and *f*8.

When rapidity of exposure is of greater importance than is clearness of definition in the corners of the picture, it is often practicable to use a moderately large-aperture short-focus lens to make a negative of a size or two larger than the lens is designed to cover. But for the technically finest wide-angle results it is essential to employ a lens designed for the work. This is especially the case if interiors with windows or with lighted lamps are photographed. Halation is often as much accentuated by the use of imperfect or unsuitable lenses as by the use of unbacked (and therefore unsuitable) sensitive material. (*See* Halation). Wide-angle lenses are necessarily of smaller working aperture than others, and where inclusion and sharp rendering of detail over a very wide angle is more important than an appearance of naturalness in the perspective, it is essential to use a wide-angle lens of the type whose maximum working aperture is *f*16 or smaller.

Many interesting architectural subjects exist in rather confined spaces, where it would be desirable, but is actually impossible, to obtain a more distant viewpoint. The little space between camera and far wall which seems unavoidable may make just the desired difference in improving the perspective and in inclusion of sufficient detail. In such a case it is often practicable to set the focus on some other matter at an equal distance elsewhere (or to employ the distance-scale), or again to rely on the natural depth of focus of a small aperture and actually to support the camera right against the farthest possible object. A simple way



'THE STAR INN.' An ancient inn in the sunlight has an atmosphere of peace, though, like this old smugglers' den, it may have had a violent history. A record of a subject such as this may have both a specialized architectural and a general pictorial interest

Photo, F. Read; Zeiss Ikon Trona, f8, 1/25 sec.

to make a tripod of any type do this is to use one leg only as a strut, the camera leaning by its own weight against any convenient upright.

Much architectural interest lies in gargoyles and the like which are inaccessible. These distant details can be best photographed either with a really long-focus lens on a quite unusually sturdy camera or by means of a telephoto lens. For the specialist in this work it may be suggested that a plywood extension box for a small camera affords the rigidity and the length of camera so essential to either of these methods.

Pictorial Considerations

In recent times, judging from photographic exhibitions and competitions, architecture has not been made the subject for pictorial treatment to the extent that was the case twenty or thirty years ago. It is possible that modern small cameras and high-speed material have tempted the amateur to work in fresh fields that do not call for the contemplative methods and long exposures that many phases of architectural photography demand, and interest has waned accordingly.

Yet there is much in its favour ; it can be done the whole year round, and can provide many fine pictures if approached in the right spirit. It differs from landscape work in the fact that every subject we can classify as architecture has been made by man, although frequently modified by processes of nature. It is not necessary, however, to devote one's attention to cathedral interiors on the grand scale ; smaller vistas and isolated " bits " are frequently more effective, while many modern buildings can claim attention as fine pictorial subjects.

If the matter is being undertaken seriously it may be well for the photographer to become acquainted with the various styles of architecture and their development through the ages. This will enable the subject to be more fully appreciated.

In all architectural photography, apart from the subject matter itself, one of the greatest factors for pictorial effect is the play of light and shade on stone. If these effects are watched for and their progress noted during different hours of the day, more successful results will be secured. The modern pan. plate or film has infinitely greater latitude and will render the textures and tone values better and more easily than was possible in the days gone by, and this should be a further incentive to specialize in this subject.

For the same reason exposures are considerably reduced, and it is seldom today that the long exposures, running into hours, that used to be normal with slow material will be necessary.

The varied beauty of many outdoor architectural photographs is enhanced by suitable skies. These may be introduced by double-printing (*see* Clouds), and the tone of existing skies can be effectively controlled by the use of filters (*see* Filters) as well as in many cases by employing a polarizing screen (*see* Polarized Light).

To photograph the interior of churches and public buildings it is usually necessary to obtain permission, and occasionally this is obtainable only on payment of a fee. For amateur photographers, however, the fee is usually very small. (*See* Permits to Photograph).

ARCHITECTURE AND THE MINIATURE CAMERA

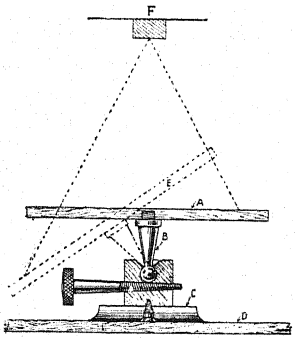
The correction of " stagger " in fixed lens type cameras explained, with practical hints and illustrations

Whilst the miniature camera is of extreme value for those photographers whose subjects lend themselves to the fixed lens type of camera, when it comes to architectural work this fixed lens type is hardly suitable, unless one is able to ascend to some point opposite the centre of the object. True the wide angle lens will help to keep the correct perspective, until one approaches near to the object, but unless the axis of the objective can be centred we get " stagger."

If the miniature camera could be fitted with such refinements as a rising front and a swing back, all would be well, but since this is not possible so far, those staggering lines have to be straightened up by some special enlarging means.

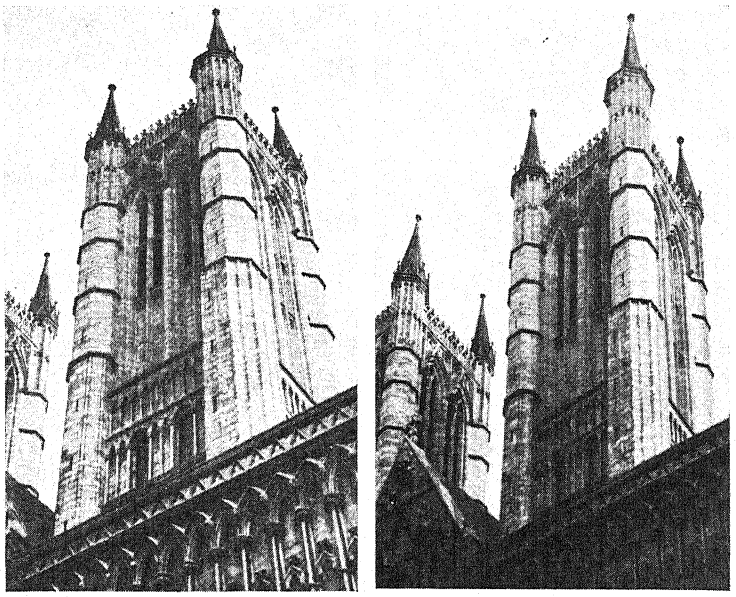
I have, in the past, made a number of photographs of cathedrals and have been troubled with " stagger," and have had to correct this through the medium of a tilting

board for the bromide paper. This tilting device can be a home-made affair, built up as follows: On the underside of a good deal drawing board (A), measuring about 12 square inches, a bush should be fitted to carry the screw of a universal tripod head. This tripod head is fitted with a



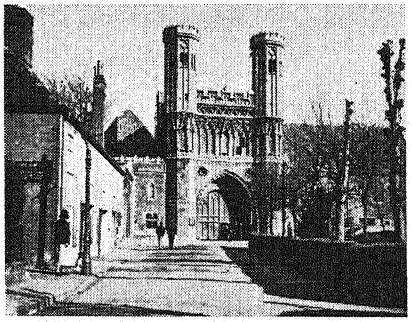
ball and socket head (B), allowing the board to be clamped at any angle.

To prevent the board toppling over when in use, the ball and socket head should be fixed to a firm metal seating (C) on the enlarging table (D). When using the tilting board the negative (F) should be projected with the board in a horizontal position (A). Having sharpened up the subject and arrived at the size, the board can be gently tilted to the desired angle (E) until the converging lines of the building return to the vertical. Then, taking the centre of the tilt as the focussing point at *f*3·5, the iris of the lens can be closed until the whole of the subject is in focus. Of course, this stopping down of the lens will mean greatly increased exposure, and it is wise to replace the usual bulb in the lamphouse with one of higher wattage, say 100 watts at least.



PREVENTION OF "STAGGER." The tilting board explained in this page is shown diagrammatically on the left. Above are seen (left) a photograph before correction, and (right) the same photo with verticals corrected

Fox Photos and Trem Passingham



Where the foreground is interesting, little trimming is needed



Here much foreground has had to go

The diagram will convey the constructional details, which are in reality very simple.

I have found from experience that the Leitz Universal finder enables the miniature photographer, when working on architectural subjects, to visualize accurately, whether using a wide-angle, normal, or long-focus lens.

The two illustrations at the top of this page tend to show how distortion in the negative can be corrected with a tilting device as described.

The other two photographs exemplify the art of trimming foreground.

ARTHUR BARRETT, F.R.P.S., F.R.G.S

ARGUS CINE CAMERA. An all-British camera of robust construction and good design, made by Thames Cine Products, Ltd., at Ashford, Middlesex. Both 9.5-mm. and 16-mm. cameras are marketed, and these have several special features. The body is of die-cast metal throughout, a revolving turret allows any one of three lenses to be instantly available, and camera speeds of 12 to 64 frames per second are provided. A reverse movement permits of trick photography, and is useful for dissolves and double exposures.

In addition, a selector enables single pictures to be taken, if desired. A direct-vision view-finder is provided, marked for normal, wide-angle and telephoto lenses, while a view-finder of the reflector type is attached to the camera body. The footage indicator is conveniently placed so that it can be watched all the time while filming, and when the reverse movement is in operation this indicator runs backwards.

To facilitate cleaning, the whole of the gate unit and the sprocket wheels may be lifted out. The daylight loading spools (obtainable in 50-ft. and 100-ft. lengths) are easily loaded into the camera. When the small knob in the centre of the gate unit is given a quarter turn, the latter clears the sprockets and film-channel, leaving ample room for the film to be introduced.

The motor spring is provided with a spring load indicator which shows at a glance the tension of the spring, so that there is no fear of filming with insufficient winding to complete the shot. A full wind exposes about 18 feet of film.

ART IN PHOTOGRAPHY: SIMPLE PRINCIPLES

W. L. F. Wastell, Hon. F.R.P.S.
Past President R.P.S.

Ever since photography reached practical form there has been controversy whether or not it is an art. Today, however, adverse criticism is far less marked, and it is generally accepted that the camera can rightly rank as a medium of artistic expression. The different points of view on the subject are given in the following lucid article

LEONARDO DA VINCI once lashed out at contemporary critics who contended that painting was merely a mechanical art because it was done by hand. In modern times it has been argued that photography is purely a mechanical process, and in no sense a form of art.

Except among those who are unfamiliar with what photography can accomplish, these arguments have died down. Some of the finest art galleries in this country and abroad have gladly opened their doors to photographic exhibitions as an important factor in art education, and the attendances have more than justified the decision.

The Dividing Line

It is difficult to draw even an approximate line between good craftsmanship and fine art, just as it is between prose and poetry. But that photography is capable of producing fine examples of graphic art there can be no doubt. No one has been able to evolve a definition of graphic art which would include, say, monochrome drawings and etchings and exclude all photographs.

For the present purpose it will be convenient to use the word " artists " to signify those whose medium is oil or water colour pigment, pen and ink, crayon, pastels, the etching needle, and so on ; but this does not imply that some photographers, at any rate, are not fully entitled to rank as " artists."

It has been generally stated that in the very early days of photography there was scarcely a thought of any " pictorial " possibilities. The limitations of the new craft were numerous and severe. It was not only a mechanical process, but a difficult and uncertain one ; and it was considered no small achievement to produce a print that was a " clear " and " sharp " record of the subject. Lenses for the work were scarce and of poor optical quality ; the only negative material was paper of very low sensitivity. It was not till much later that improvements in apparatus began to arouse faint hopes that photography might become a medium for artistic expression.

These statements have been accepted without question, and in the main they are



PIONEER PORTRAITURE. Resembling in texture and treatment a portrait in oils, this Calotype photograph is an outstanding example of the work of David Octavius Hill, the Scottish pioneer. This portrait of Professor Alexander Munro, tertius, was taken nearly a century ago
Courtesy of J. Craig Annan

correct. But they ignore the fact that in those early days, and in spite of all the serious limitations, there were produced certain photographs which to this day are recognized and admired as works of real art.

As early as 1843, David Octavius Hill, a Scottish artist, was commissioned to paint a group containing over a hundred portraits. He had experimented with Fox-Talbot's Calotype process, and he set to work to make photographic portraits of the persons to figure in his painting. Many of his original prints are in existence, and others have been made from his paper negatives. An idea of their merits can be obtained from the examples shown in this page.

Another early photographer, Mrs. Cameron, with facilities not much better than those of Hill, also produced many portraits of wonderful vigour and character.

The significant fact that emerges from these two achievements alone is that the artist triumphed over his medium, the limitations of which were unable to fetter his ability. And today it is still true to say that it is not the camera that matters but the man behind it; which amounts to saying that photography can be an art in the hands of the artist.

For a considerable time progress in the direction of "pictorial" photography was slow. Artists ignored or derided the process. Incredible as it may seem today, there was a convention that a sky should be "clean," and if the negative was not dense enough to ensure this, they painted the sky over with opaque pigment. Their "colour values" were inevitably wrong, but they were blissfully ignorant of the fact, and considered the jeers of artists quite unjustified. Adventurous photographers who broke away from convention were derided by their fellow-practitioners.

After a time, however, some of these workers began to pay serious attention to the selection and composition of their subjects, to lighting, to atmospheric effects, to tone and colour values; but they were still handicapped by the apparatus, and particularly by the material then available.

One method adopted for remoulding photographs nearer to the heart's desire was combination printing. By short exposures and curtailed development, "cloud negatives" were produced and used with varying success for printing-in skies to "bald-headed" landscapes. The results were often disastrous because the perpetrators had no idea that there was any definite

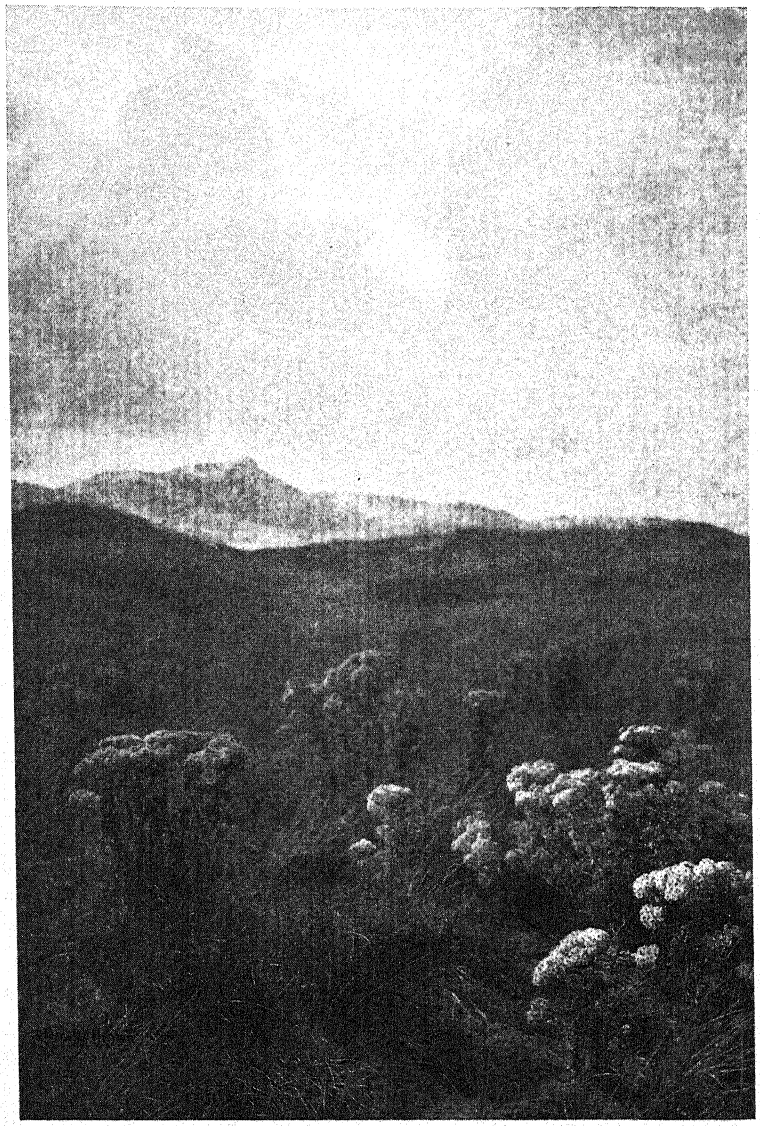


CALOTYPE OF THE "FORTIES." In 1843 and succeeding years David Octavius Hill produced many photographs of startling vigour and fine quality. Here is one of his Calotype portraits which is a triumph of photographic technique
Courtesy of J. Craig Annan

relation between sky and landscape. The method is still practised, with somewhat similar results.

O. Rejländer, a Swede by birth and a painter and sculptor by profession, went much farther in combination printing. In 1857 he exhibited a print, three feet long, of a sort of allegorical subject called "The Two Ways of Life," in which he introduced over thirty figures from separate negatives made in his studio. H. P. Robinson, later, produced some really good composite prints which were not only examples of great technical skill, but compared quite favourably with similar subjects by artists of his period. Similar methods are still in common use.

Another device for attempting to modify the shortcomings of a negative was retouching. Medium was applied to the negative to enable pencil work to be done upon it, and this was carried to an extent in portraiture that resulted in the natural contours and surface textures of a face being transformed into a sort of billiard-ball smoothness. For landscapes and other work the glass side of the negative was coated with matt varnish on which work was done with pencil, crayon and slump.



WORK OF A SPECIALIST. Pictorial photography was advanced considerably by A. Horsley Hinton, whose method was based on the use of three or more negatives for a single picture. Here, in this example of his controlled work, his multi-negative process has been used successfully to give a delicate pictorial effect

By permission of F. J. Mortimer

A. Horsley Hinton had a strong influence on his photographic contemporaries, and gave a great impetus to pictorial photography. He often used at least three negatives for foreground, middle distance and sky, and they were often elaborately worked up with pencil applied to a sheet of *papier minéral* stretched over the glass side. Many of his results, mostly landscapes, were strikingly good, especially in comparison with the average work of his period. He had the advantage of being a clever draughtsman.

But even before his time photography, not only as a craft but as an art, had begun to attract great attention, and progress, at first slow, moved with accelerated velocity.

Great and constant improvements were made in apparatus, materials and methods. Photographic societies sprang up everywhere, and frequent exhibitions were held.

An important fact was that photography was rapidly becoming a popular hobby, and it was the amateur rather than the professional who made the greatest progress in photographic art. The art side of photography was seriously pursued, and every year saw an increasing number of workers whose prints could justly be described as " pictures."

A Wonderful Record

In course of time reproduction methods became readily available, and we can study reproductions of prints covering more or less thoroughly most of the photographic era. In 1894 appeared a monthly photographic magazine called " The Photogram," and shortly after its establishment it began to issue an annual volume called " Photograms of the Year," which was devoted to the reproduction and criticism of notable prints produced during the year. These volumes enable us to study the evolution of art in photography. Some of the results were crude, others experimental, while a considerable number reached an artistic level that would cause amazement in those who are not familiar with the work of the past. Some of it has never been surpassed in its particular class ; and many " modern " photographers would be surprised to find that their " original " ideas were carried out a quarter of a century ago.

In 1912 " Photograms of the Year " came under the direction of F. J. Mortimer, whose reputation, especially for pictures of the sea in all its moods, is world-wide. He enlarged the volume, improved enormously the quality of the reproductions, and gave the book an international character which it still maintains. Every year it contains reports of the progress of artistic photography in all the chief countries where it is practised.

Mirror of Photographic Art

The work in its entirety is a wonderful mirror of photographic art the world over during the last quarter of a century ; and those who have aspirations in the same direction should study it to see what has been done already, and to try to visualize the possibilities of the future. For art in photography is far from static. It expands and advances continuously. Like other graphic arts it has its ebb and flow, its changes of form, fashion and mood ; but on the whole its movement is forward and upward.

By what means can the photographer raise some of his results above the level of mere craftsmanship into the higher realms of art ?

Any answer to the question must be complicated and difficult. As has been hinted already, art presupposes the artist ; and the true artist is rare. Only a comparatively small proportion of those who practise photography with more or less zeal achieve the ability to produce considerable numbers of prints with a consistently high character and quality. This is not because the technical side of photography is particularly difficult. On the contrary, what may be called the mechanical side of the work is easier than that of any other form of graphic art. The artist may spend long years in acquiring the manual dexterity required for him to accomplish his ends ; the photographer may begin to express himself almost at once, although much time and labour must be devoted afterwards to his further progress.

Technical Progress

Most of the mechanical and technical difficulties of the earlier days have been removed by the labours of the optician, the makers of apparatus and material, the research chemist and others who have been attracted to the world of photography. No longer does the pictorial photographer have to doctor his negatives in an attempt to rectify their shortcomings ; his negative material, properly used, will give him all he desires in the way of definition, tone gradation and colour values. Instead of one monotonous printing paper, he has available a host of processes which enable him to select any colour and quality of image on papers with a wide range of surfaces.

He may, and does, modify his results by various means to suit his aims and desires. What is called " control " by some and " faking " by others is still practised, and probably always will be. But there is a growing tendency towards relying on " pure " or " straight " methods. Serious modifications are becoming unnecessary. The special

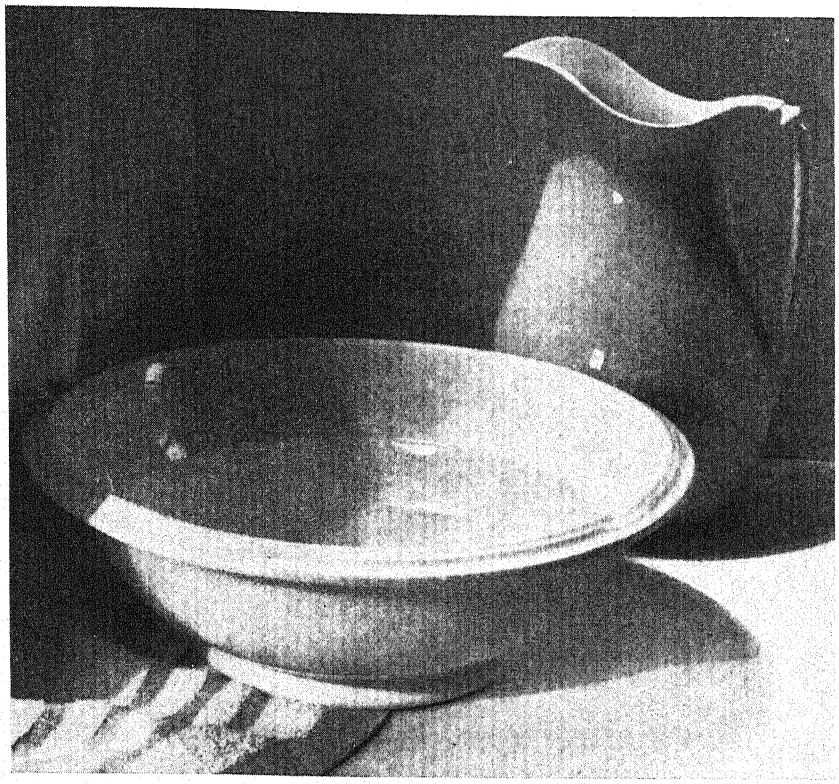


NATURAL COLOUR PHOTOGRAPHIC PRINT

This superb study by Dr. D. A. Spencer, employing the Vivex colour process, is an excellent example of the achievements which modern colour photography has now made possible. The delicate shades of the background and water, and the brighter hues of the children's dresses, are all captured with equal clarity ; and the whole is, moreover, an excellent pictorial composition that would have been of the first rank as a monochromatic photograph. Comparison may be made between this example of colour and other colour plates by other processes that are given in later pages in connexion with the long series of articles under the heading Colour Photography

Photo by D. A. Spencer, Ph.D., D.I.C., F.R.P.S., from negatives made with a Vivex one-shot camera, exposure 1/50 sec. at f 4.5. Courtesy of Colour Photographs (British and Foreign), Ltd.

To face page 117



ART IN THE HOME. This beautiful study—Mrs. Rowena Brownell's " Bowl and Pitcher "—proves that art can transform the homeliest subjects into things of beauty by skilful use of contrasting lights and lines

characteristics of photography are strongly marked and unique and lend themselves admirably to pictorial expression. Extraordinary definition and detail are obtainable if they are required to delineate form and texture, but both definition and detail are under control, and can be modified at will. Above all, a photograph can be made to show a range and subtlety of tone gradation unattainable by any other method.

Then there is the extraordinary speed of the photographic record. An artist may wish to portray in his particular medium some effect or arrangement so transient that he must trust almost entirely to his memory in recording it subsequently; the photographer can secure his record in a fraction of a second. On the other hand, the artist can produce pictures which are completely outside the photographer's range.

This should be recognized by the photographer with pictorial aspirations. He must learn to work within the limits of his medium; and if he attempts to follow the artist in certain directions he is heading for disaster. He must learn to recognize the subjects—and they are many and varied—which lend themselves best to treatment by photographic methods. One of his most promising fields of work will be in the representation of effects of light and shade. Sunlight, with its accompanying shadows, will be his powerful friend; and he can learn to do wonderful things with artificial light which is under his control. The very foundation of photography is light in its various forms and manifestations.

The art worker, too, must naturally study —although he should not follow slavishly— the " rules " of composition (*q.v.*). That is, briefly, that he must learn to arrange his subject in the picture-space with due attention to the disposition of its component parts in relation to the " frame " and to each other. The same " laws " obtain in photography as in other picture-making media. But above all he must have *vision*. He must see clearly, and understand fully, exactly what he wishes to record, and then he will have to apply all his knowledge and skill to presenting it in the most effective and intelligible manner possible.

It is taken for granted that one can never produce a perfect picture unless one can make a perfect print.

A word or two about the illustrations accompanying this section may help to emphasize some of the general hints given.

In Constable's well-known painting, " The Valley Farm " (p. 100), a few points may be noted. The boat—placed in a " strong " position in the picture-space—carries the eye to the cattle, and thence up the stream to further details suggesting distance and atmosphere. On starting again from the boat the eye sweeps up the mass of the principal trees, and the direction is continued by the clouds. By either route the eye cannot miss the finely lighted and arranged mass of the building. The whole canvas is filled with objects of interest, some of which dominate others. No photographer would expect to find all this detail and arrangement awaiting his arrival at some particular time. Neither did Constable so find it. He based his picture on natural details, but he arranged and modified them to suit his purpose.

The photographer has less freedom. He can control and modify up to a certain point—even to the extent of " importing " material—but he is largely dependent on facts and circumstances. Yet L. A. B. Edenborough, an amateur photographer, has made quite a pleasing picture of " Lott's Cottage," as it now stands. (p. 100). He has laid stress on the soft glow of light and the peacefulness of the scene. It would not appeal to a house-agent advertising the property, but it pleases the eye, soothes the mind, and arouses vague memories of other pleasant peaceful scenes. In its way, therefore, it is " art."

Theme with Simple Things

Mrs. Rowena Brownell, like many others, has taken simple and homely objects for her theme (" Bowl and Pitcher," page 117). It is a straightforward task to photograph a jug and basin so as to make it suitable for a china-dealer's sale catalogue; it is quite another matter to make the same objects artistically interesting and pleasing.

The original 11 × 10 in. bromide print affords a sensuous pleasure by the delicate beauty of its tones and the skilful combination of curved lines and surfaces. Shadows play their part, and so do the few more or less straight lines that give stability to the composition and connect the objects with the frame. It is not a " likeness " of a jug and basin, but a beautiful study in form, light and shade balance and tone values. Japanese photographers who have not yet become occidentalized are particularly skilful in their treatment of the simplest and slightest of subject matter.

It is by such examination and analysis of photographs, and not by verbal definitions and explanations, that we gradually obtain a coherent idea of what is meant by " art " in photography; and this is the first step towards achieving it.

ART TERMS USED IN PHOTOGRAPHY

In describing or criticizing any photographic work a number of recognized terms are used to define the qualities and characteristics of the subject under review. The more important of these are given below

Accentuation. The inclusion in a picture of some force, such as a strong high-light, which gives emphasis to a particular part so that it acquires additional prominence above the whole.

Background. The area that lies behind and is subordinate to the predominating subject or subjects in a picture.

Balance. The disposition of various features in a photograph which gives harmony to the whole setting.

Breadth. The suppression of all superfluous detail.

Chiaroscuro. The technique of aptly distributing in a picture the lights and shadows.

Composition. The constructive faculties which are essential in amalgamating the various components of a picture so as to give harmony to the completed work.

Contrast. The pronounced opposition of different features in a photograph, particularly that existing in light and shade and linear formation.

Detail. Those features in a picture which, in contrast to the main motif, may be of no particular value.

Flat Tint. A uniform colour which is completely devoid of gradation.

Foreground. The area in any pictorial composition disposed in front of the principal figures or objects.

Formal. Appertaining to the shape of any object.

Genre. A style of picture which portrays a scene or incident of ordinary life in its most natural form without pose or artifice.

Gradation. The progressive blending of different tones or tints.

Group. Two or more figures or objects arranged so as to form a complete design or part of a picture.

Half-Tones. Those degrees of brightness found in a picture which lie between the two extremes in the range of light intensity.

Harmony. The apt arrangement or combination of pictorial features whereby an agreeable effect is obtained.

Impressionism. A style of art which aims at depicting vividly the initial impression registered upon the observer's mind on viewing an object, without any regard to conventions of lighting and composition.

Key. A term used in relation to tone values of a photographic picture. A photograph characterized by light colours generally is said to have a high key, while one having tone values of a dark colour is described as having a low key.

Medium. Material employed in evolving any artistic work.

Motif. The dominant idea upon which a picture is based.

Proportion. The comparative relation between different parts in a picture.

Relief. An arrangement of colour and line which gives prominence to an object against surroundings of lighter texture.

Rhythm. Harmonious correlation of features designed to give a pleasing effect.

Silhouette. The appearance of an object when all is suppressed except the outline against a contrasting background.

Subordination. The secondary value of certain parts of a photograph when compared with other parts.

Suggestiveness. That quality in a picture which by a certain indefiniteness of form stimulates the imagination so that something is seen that is not actually represented by colour or line.

Symmetry. The right proportion and distribution of various components in a picture.

Tactile Values. Values that refer to relief or projection as realized in sculpture and suggested in painting or photography.

Texture. The representation of surface in a picture.

Tone. The general effect produced by light and shade in a picture.

Touch. Individual style produced by hand.

Value. The degree of effectiveness of colours in a picture.

ARTIFICIAL LIGHTING FOR INDOOR PHOTOGRAPHY

Bernard Alfieri, Jr.

The newer films and the effective lamps for extra lighting now available, together with faster lenses, enable the amateur photographer to produce excellent indoor studies. Modern lighting equipment and new technique have also brought vast improvements to professional photography. Here, the latest apparatus and methods of using it for both beginners and more advanced workers are fully described. This article is illustrated throughout with photographs by the author

See also Electricity; Lamp; Lighting; Panchromatic; Portrait Work

PHOTOGRAPHY by artificial light is now within the range of every photographer, and the question of which form or how to make the most of artificial light is a matter of importance to the beginner, the experienced amateur, and the professional alike.

Electric lamps of the ordinary household type, which can be purchased in sizes from small bulbs to the enormous lamps employed in a film studio, are particularly suitable for photography of almost any class, for they are steady in output, easy to handle, and economical in consumption. For most amateur work, however, and for certain professional uses they have been, to a large extent, superseded by overloaded lamps of a similar construction. Within certain limits, the more an electric bulb is overloaded the brighter and more actinic the light obtained, and at the same time the shorter the life of the bulb. Photoflood bulbs are small lamps overloaded to such a degree that their average life is about two hours. Larger lamps of roughly the same lighting output, but with a life of about 100 hours, do the same work photographically in a more economical form, and owing to the relatively low current consumption several bulbs of this class can be run without any special heavy wiring in the home and will produce sufficient light for almost any form of indoor photography.



ARTIFICIAL SUNSHINE. To gain a sunshine effect one lamp of the photoflood type at one side and a general soft front lighting by two 100-watt lamps in reflector covered with a diffuser were used for this photograph
1/50 sec., f3.5., *s.s. pan.*

In modern photography much progress has been made in the production of artificially lit pictures that possess the simple directness of a single light source with the familiar atmosphere of direct sunshine. " Candid " portraiture intended to show a face or figure as we see it, depicted with the atmosphere of life and character, can be obtained by artificial light, the length of exposure depending on lens stop and light. An exposures graph is given under the heading Exposure.

It must be remembered that when photographing in direct sunshine there is a considerable amount of reflected or general light which plays a large part in softening shadows, even where no attempt has been made to avoid excess of contrast, and for this reason, if a very bright artificial light is employed in an otherwise dark room without some balance, the effects will not be parallel.

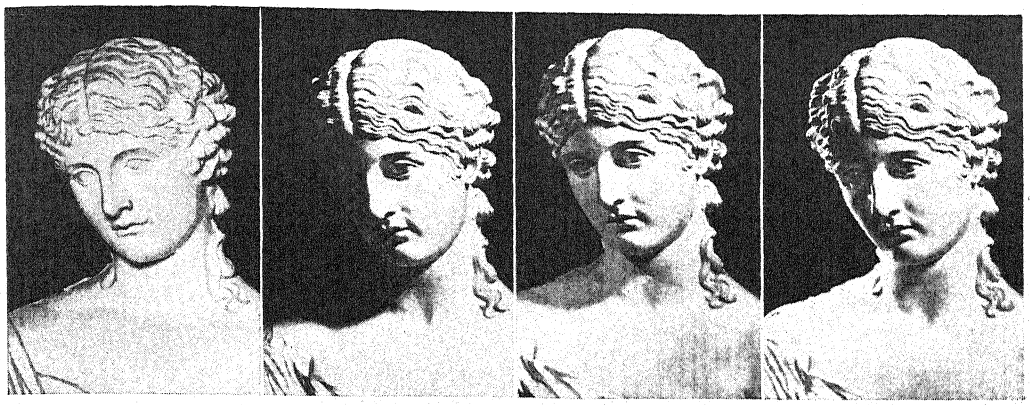
Some form of general or front lighting must be added, as shown in the photo in this page. This photograph, taken on fast panchromatic film, was lit by one large lamp of the overloaded type on the right-hand side, whilst a soft front light reduced the excess of hard shadow. Using a lens at *f*3.5, an exposure of 1/50 sec. was possible.

Before going further into detailed description of the methods of applying artificial light, it is necessary to define the difference between the quality of the light which can be obtained from the same source. A single electric lamp used without a reflector will produce a hard light capable of casting a single shadow, the crispness of which depends on the area of the lamp-filament. In this form it may be useful for obtaining those hard shadow effects which are often employed for the contrasty lighting effects intended for reproduction. If the area of the filament is reduced by interposing a card or screen so that the light is caused to pass through a small hole before reaching the subject, the shadows become more clearly defined, as the spread of the light source is reduced.

Conversely, if the lamp is used in a suitable reflector the effective area of the light source is thereby increased, and the nature of the light is softer and its shadow not so clearly defined. By interposing a diffuser, such as a frame covered with fine net, the shadows are further reduced.

Soft Lighting. For very soft general lighting, lamps are often arranged in a large reflector, and even obscured from the front by reflectors, so that a large area of reflected light alone reaches the subject. This form of soft general light is often used in portraiture, and forms a convenient basis on which to produce the amount of shadow from additional lights. In the photo in this page the front light was obtained from two ordinary 100-watt lamps in a large reflector with a diffuser, and used about 10 feet away.

This light was easily overbalanced by a single large bulb of the overloaded type in a reflector, held about 3 feet from the subject. Bearing in mind that the light falls off as to the square of the distance from the subject, and also the much greater actinic value of the single light, the general illumination is practically unnoticed in the photograph, and the effect is that of a single light source. Such pictures may often capture the spirit and atmosphere of the subject, but they are not always kind enough to subdue those portions of the face which its owner would prefer unemphasized, whilst on the other hand characteristic features may be lost in the general effect.



FOUR LIGHTING METHODS FOR PORTRAITURE. On extreme left is a plaster cast, here representing a typical sitter, illuminated with a soft general light from the front. Next, the head is lit from one side. The third photo shows the cast lit with the side light of the second partly reflected on the opposite side, and with the general front light also on. In the right-hand picture another lamp has been added on the shadow side nearly behind the cast

Conventional Lighting. Few of us are honest enough to be pleased with a picture which does not show our features in the best possible light, and quite apart from those who prefer a highly retouched representation of a face, much can be said for the more conventional methods of lighting a face or figure.

Whilst the effectiveness of any artificial lighting must depend on the personal skill and good taste of the photographer, there are certain accepted methods that are helpful, if not absolutely essential, as a basis on which to vary individual methods.

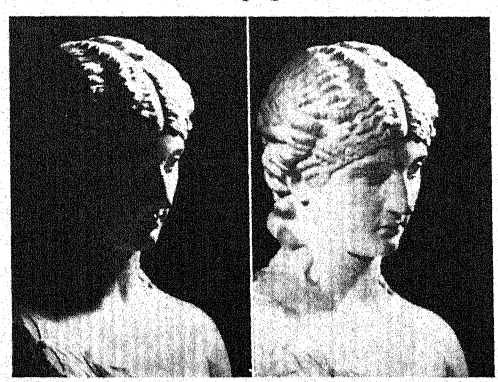
A plaster cast is particularly useful as a means of demonstrating the various stages of lighting the human head. In the strip at the top of this page, the left-hand photo shows such a cast lit from the front with a soft general light. The object of this light is to soften off hard shadows that may be added later, and to ensure some detail in the darker portions.

Switching out this light in order to show the next stage clearly, the head is lit from a much more direct light on one side (second photo), the height of the light being such that it meets the subject at roughly an angle of 45 deg. This will give roundness to the head, and a light and dark side; it should be high enough to leave a shadow from the eyebrow, and if a simple lighting is desired it is usual to bring this lamp forward until the light just catches the opposite cheekbone.

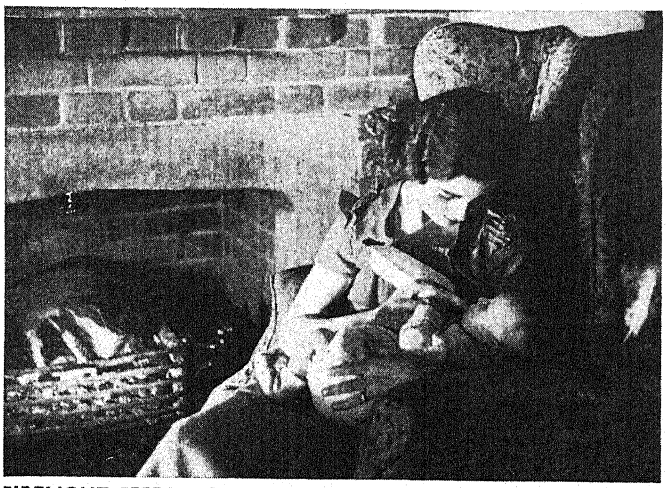
In order to leave a shadow side to the face, but soften off the shadow itself, a reflector is sometimes used on the opposite side to reflect part of the light back and give detail in the dark side of the face, as shown in the third photo, where the general light from the front has also been switched on. This illustration represents the usual method of using two lamps and a reflector.

On the right we have a stage further in the sequence, where an additional lamp placed on the shadow side, nearly behind the face, destroys the main shadow on the shoulders produced from the main modelling light, and provides a high-light, or bright outline on the shadow side. If the brilliance of this light is increased considerably in proportion to the balance of the lighting, the halo behind a head that is associated with pictures used for film work can be produced; and whilst such lighting arrangements are essentially artificial in character, they often present a striking and bold effect.

Very simple lighting indeed is shown at the bottom of the page. A strong and



SIMPLEST LIGHTING EXEMPLIFIED. Left, a hard strong light is used, high up and nearly behind the head; ri… a reflector on the shadow side has been added



FIRELIGHT EFFECT. This photograph was lighted with a flash-bulb concealed near the back, a firelight effect suitable to the subject being obtained
Miniature camera, on s.s. pan. film, f4

rather hard light is situated high up and almost behind the head, as shown on left. Then a large reflector, or a second much softer light, is used on the shadow side, with the result shown on right.

From these simple beginnings the positions of the lamps can be varied to suit almost any subject, and provided it is remembered that any great preponderance of light from one position must be nearly balanced from the opposite side, little serious trouble should be experienced.

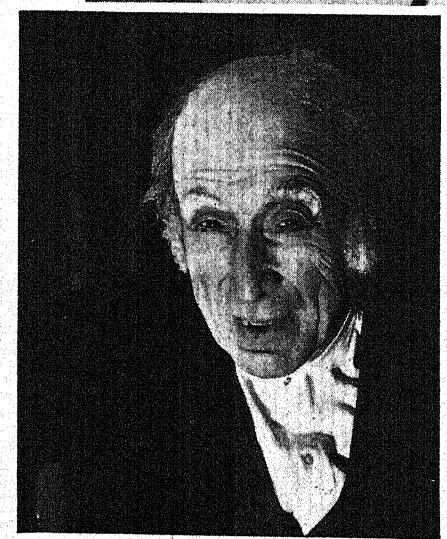
Arc Lights and Mercury Lamps. Arc lights have a specialized application, as the source of light is confined to a single spot, and such lamps, apart from possessing great actinic value, are capable of producing very clear-cut, sharp shadows. Their light is essentially hard and contrasty in nature, for which reason they are applied with advantage in the commercial studio; but as they present some inconvenience in handling even when they are of the self-fed type, their use is restricted.

Although they are still used in the film studios, where they are rather aptly referred to as "the blues," they are employed with discretion, and their place is filled by large lamps of the gas-filled type where possible.

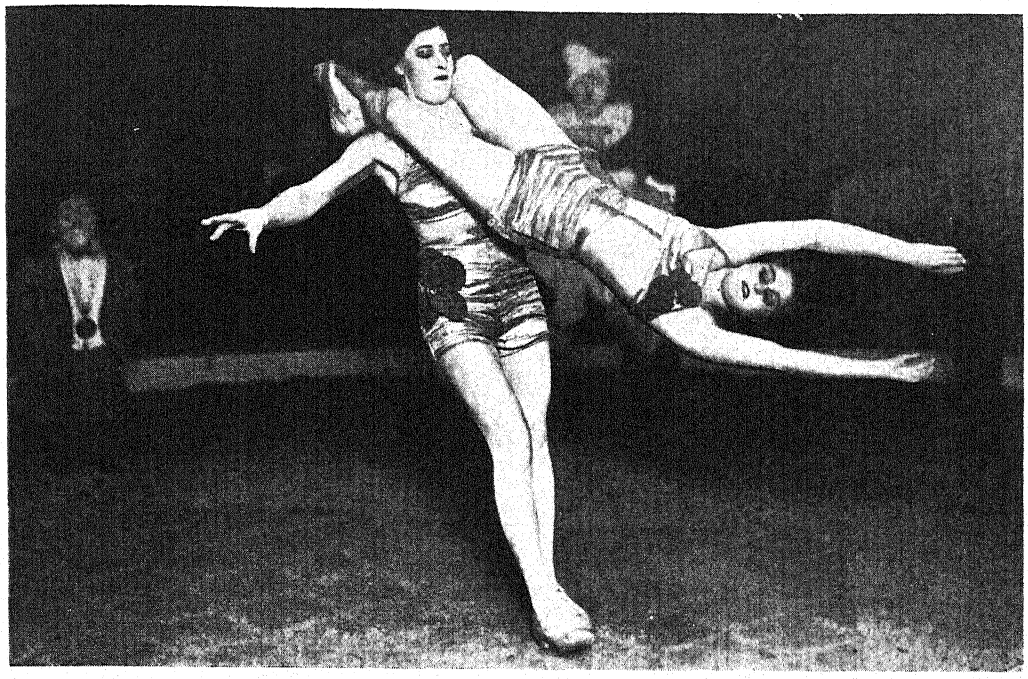
Mercury vapour lamps, on the other hand, are also very actinic; recently small lamps of enormous light value have been introduced which are essentially soft in character. They are very economical indeed, and are used in street lighting. The unfamiliar appearance of the human face when seen in the light of these lamps is happily not registered photographically. Unfortunately, their installation necessitates certain additional apparatus, and for this reason few amateurs are able to take advantage of them.



ANOTHER DOMESTIC INTERIOR. Artificial lighting in a setting not naturally bright is here obtained with a flash-bulb and nearly front lighting
f5.6, s.s. pan.



LOW LIGHTING. What might otherwise be a pleasant smile is here given an evil significance by front lighting from a low position
One flash-bulb, f3.5, s.s. pan. film



SYNCHRONIZED FLASH. Swift action like this needs a short exposure with flash powder itself tripping the shutter 1/1000 sec. exposure, f3.5, s.s. pan

Flashlight and Flash - Bulbs. Whilst flashlight may be regarded as a separate subject it is a form of artificial light, and much that has been said of other lighting also applies to a flash. In powder form, flashlight offers enormous light value, with many reservations and difficulties.

In its simple application on dark subjects the camera shutter is opened and the flash fired, after which the shutter is closed, the actual exposure being the duration and brilliance of the flash. (*See* Flashlight.)

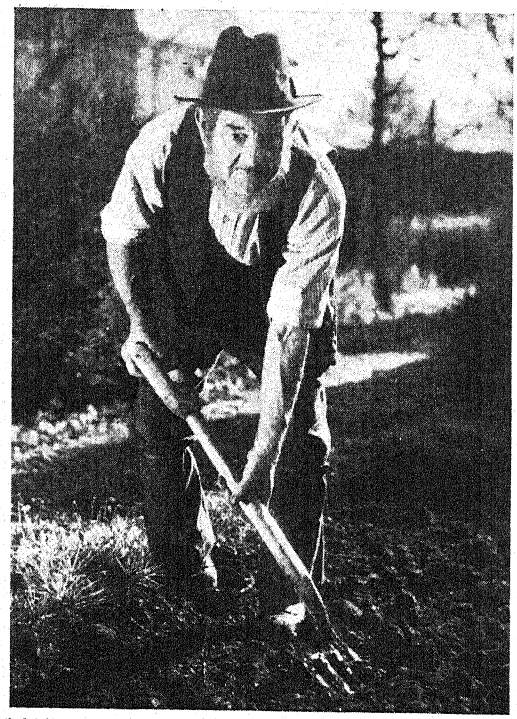
Although this is still the only way to obtain a very brilliant flash at small cost, its use has very largely been superseded by that of the flash-bulb. Whether powder or bulb is employed, the following fact is sometimes not realized: if the flash is immediately behind the camera, the lighting will be flat—that is, it will not present roundness; whilst, on the other hand, a single light used well to one side without a reflector will give very dark shadows.

On the other hand, if a flash-bulb is used at an angle of about 45 deg. to the camera, which on close-up subjects means roughly at arm's-length from the camera, sufficient shadow or roundness can be obtained for many subjects. The centre picture in p. 122 was obtained in this way, and although the lighting is rather flat in nature, it can still be effective. Particularly with flash-bulbs, the light source can be varied to suit the subject, as in the top picture in the same page, where the bulb was concealed near the back, and gives the atmosphere of firelight.

Front lighting from a low position on a face regardless of the camera position is often effective in character studies, as shown in the bottom picture in p. 122. The actual position of the flash is determined by an electric torch, and as the effective duration of a flash-bulb is roughly 1/75 second, there is no need for a synchronized shutter.

With moving subjects by flashlight the shutter must be synchronized, so that exposure is made during the time of maximum light.

With flash-bulbs the shutter is usually set at a slow speed (from 1/10 second to 1/20 second), the photographer relying on the fact that the speed of the flash itself will be short enough to arrest the motion. Very rapid action is successfully accomplished with powder flashes fired so that the flash itself will trip the shutter. The photo in this page is an example taken in this manner.



LAMP AGAINST THE SUN. For this character study, taken with the sun almost behind the figure, a flash-bulb was arranged low down to light the shaded face and arms
1/20 sec., f8, Panatomic film

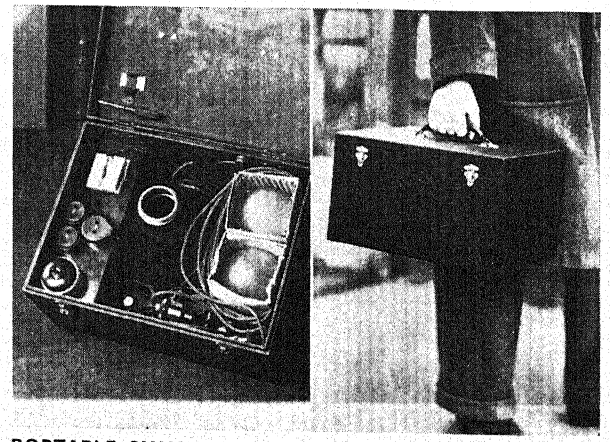
The nature of this apparatus makes it difficult to arrange special angles for the lighting, but the flashlamp should be used at least an arm's-length from the camera, if possible, to ensure roundness and a shadow side to the subject.

Artificial Light in Daylight. Apart from using artificial light as the sole means of illumination, it may often be employed in combination with daylight; although, due to the fact that sensitive film responds very differently to each type of light, some experience is required before a correct balance between each may be judged.

Indoor subjects arranged in subdued daylight can either be treated where the daylight element is used as the flat general light, employing artificial light to produce the modelling and shadows, or the subject may be arranged near a window, so that the daylight produces the contrast, while the artificial light is used as a balance to soften dark shadows and increase the shadow detail. In either case the balance between artificial light and daylight will depend on the particular film being used, and it is rarely possible to record the actual balance of light as seen with the human eye. A little experience in judging the brightness of daylight, combined with a practical knowledge as to the value of the artificial light, will enable the photographer to allow for any variation in the actinic value of each, and produce pictures of practical lighting value.

Artificial light can be employed out of doors to add high-lights to a subject where dull weather would otherwise result in the photographs lacking brilliance; alternatively, in bright sunshine a figure can be arranged in such a position that the sun produces brilliant outlines, and the dark portions of the subject are lit by artificial light.

Synchronized flash-bulbs are probably the easiest means of attaining these effects, and at top of this page is seen a figure photographed against the light—that is, with the sun almost behind the subject—in a position where a black face would be recorded if a straightforward exposure were made. A flash-bulb arranged low down on the shadow side has lit the dark portions, and the general effect, which is essentially artificial, presents at the same time a photograph that possesses a degree of clearness usually associated with the studio, but in an outdoor setting. In applying this method, a synchronized shutter is necessary to cut down the daylight element, otherwise it would be impossible not to

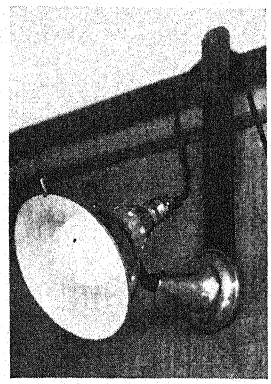


PORTABLE SUNSHINE. On left is shown a portable case of lights, with lamps, lamp-holders, reflectors, cable and control panel, which is carried as shown on right

over-expose the daylight and still catch the flash.

Bearing in mind the fact that the efficiency of the flash will be reduced by the square of the distance it is taken away, whilst the daylight portion will remain constant, the balance between them will be determined by the position of the flash, and a few practical experiments are the only satisfactory means of learning the best conditions.

Portable Lighting in the Home. Practical work in the home entails either bulky apparatus or lighting equipment that can be dismantled and packed away, and for those photographers who may wish to use artificial lighting away from home, the question of portability combined with maximum efficiency is of great importance. Excellent pictures can be obtained with two lighting units and a suitable reflector, which constitute the minimum equipment that will cover average requirements. The lower picture (left) in the opposite page shows a typical case of lights which, as illustrated on right, may easily be carried in a convenient form. The case contains two lamp holders and reflectors in the centre, two large bulbs of the photo-lamp type, a length of light cable and a control panel, which can either be operated in the case or removed as required. The panel is made up with one switch of the series-parallel type, which will permit the two lamps to be used either at full strength or dim, and two light fuses as a safeguard against burning out the household fuses in case of a mishap. The cable is fitted with a plug and combined bayonet adaptor which will cover most requirements, and it can be used either from a household lighting point or a small heating plug, the latter to be preferred. In the lid of the case a flat folding reflector is often serviceable, and a strip of wood, shown above, makes a good fixing for a lamp in a high position. The wooden strip is screwed to a picture hook, so that it can easily be hung on a picture-rail or place of anchorage, and pegs in different positions on the wood are used as a means of attaching the lamp base.



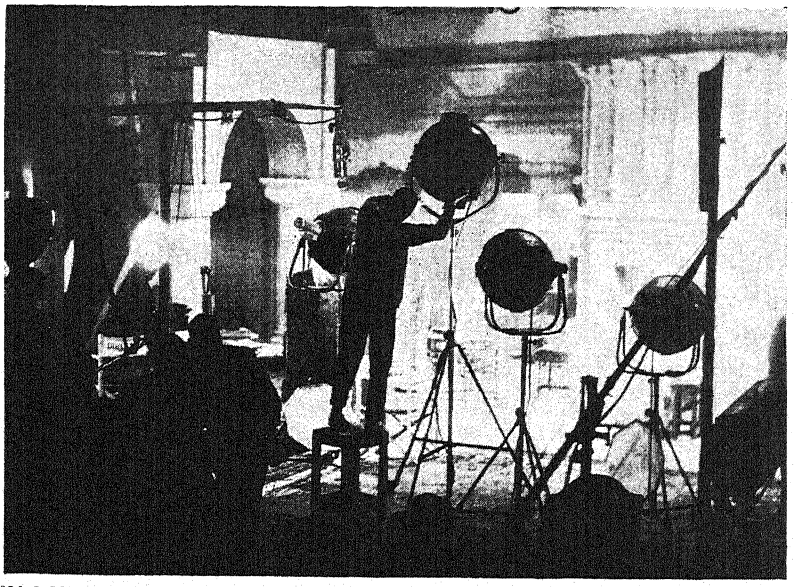
A FIXING GADGET. A strip of wood attached to a picture hook is a useful requisite in the lights-case for fixing the light, attached to it by pegs, in any desired position

ARTIFICIAL LIGHTING FOR CINEMATOGRAPHY

The three factors of intensity, balance and colour that govern artificial lighting in cine work are here considered, with special reference to the normal house supply

The three principal factors governing the use of artificial light for cinematography may be briefly summed up as follows: (*a*) intensity, (*b*) balance, and (*c*) colour. The intensity of the illumination available depends upon the amount of electricity which it is possible to draw from the supply mains. This amount is expressed in " watts," and is the product of the voltage multiplied by the amperage. Most house lighting meters are not rated to carry more than about 5 amperes, which, with a convenient voltage of, say, 200, gives a total of 1,000 watts. These figures may be found on the meter number plate, and should always be referred to previous to starting work. If there are power, cooking or heating circuits available in the house, these should always be used in preference to lighting circuits, as both the cables and the fuses on the former circuits are heavier and less likely to cause trouble through overloading.

Use of Photoflood. For cinematography in the home, photoflood lamps are the easiest solution to the problem of limited current. Each photoflood takes about 300 watts, which means that not more than three should be used at any one time on an ordinary lighting circuit, particularly where other lights may also be in use in the house at the same time. On one heating circuit, from a standard outlet point such as supplies a three-bar fire, about 15 amperes are available. This gives a total of 3,000 watts, and as many as ten photofloods may be used on one circuit. The advantage of using photoflood lamps lies in the fact that for the amount of current consumed more actinic photographic light is given than by a normal gas-filled lamp. (*See* Lighting.)



IN A FILM STUDIO. Artificial lighting *par excellence* is seen above in a commercial film studio. Large lighting projectors of the half-watt type, or Mole Richardson arc lamps, with top lighting and spot lights from a rail high above, are being used

A bare lamp emits light all round, and therefore much of the light available will be wasted unless the lamp is placed in a suitable reflector. Many types are available, from simple cone-shaped fittings to carefully designed curved reflectors. The most efficient type that can be afforded should be purchased in order to conserve the light at hand. With three lamps much interesting work can be done, but the size of picture that may be filmed with a high-speed panchromatic film and a big aperture lens is generally not greater than a head-and-shoulders shot—*i.e.* a medium close-up.

Importance of Balance. Upon the balancing of the lighting at hand depends the modelling which is given to the figures or objects included in the frame area. If all the three lamps are placed in front of the subject it will of necessity be well lit, but owing to the lack of shadows the result will appear flat and uninteresting. One rule of long standing is known as the 45 deg. rule. This means that light sources are placed at an angle of 45 deg. on each side of the subject. However, if an equal number of lamps are placed on each side the intensity of lighting will also be equal, and still the result will be flat. By moving one light farther away from the subject the intensity on that side will be reduced proportionately, and modelling will be introduced. By retaining one front light near the camera, heavy shadows can be avoided, and also a basic light is left to lift the shadows which would otherwise be formed by the cross lighting at each side.

One of the faults which most often occur in amateur work is the placing of the subject too near the background. This means either that shadows are cast upon this background and tend to confuse the shot, or otherwise the background is illuminated to the same level approximately as the subject, and a conflicting result is obtained. A spot-light, either of the lens or parabolic stippled mirror type, is a great asset in providing easily controlled accent lighting. An example of the use of a spot-light is the effect provided by placing this unit high above the subject and slightly behind it (the deep hood usually provided on a spot-light prevents light from it entering the lens), when, for instance, in the case of a fair-headed girl, a halo round the head will be formed. A spot-light is also useful for dramatic effect lighting, where hard cast shadows are required to accentuate some particular feature.

Lights for Colour Work. The colour of the light has a bearing upon its use with modern super-sensitive type emulsions. Most artificial light sources emit a preponderance of the red rays of the spectrum, and the emulsion is also particularly sensitive to this end of the spectrum, so that the combination proves exceedingly useful. The amount of light emitted in the various regions of the spectrum varies, however, with different types of lamp, and depends upon the efficiency of the lamp. While this is not of such great importance in monochrome work, in colour work it is of paramount importance

if any approximation to correct colour rendering is to be obtained. For this reason, when using colour film, care should be taken to see that all the lamps are of exactly the same type and specified voltage, and that the proper emulsion or correcting filter is used *for that type* of lamp.

While the carbon arc lamp is not very suitable for home use, there are types which are definitely suitable for studio work. In view of the development of carbons for these arcs, which have a spectral emission corresponding more nearly to sunlight than has previously been obtained, it would appear that there should be a considerable field for these, particularly for filming in colour.—*STANLEY W. BOWLER, A.R.P.S.*

ASPHALT (Bitumen). A semi-solid residue formed by the partial evaporation or distillation of certain petroleums. Most of the world's supply of asphalt comes from petroleum refineries, and for photographic purposes Syrian asphalt is generally employed as being the most sensitive to light.

This light sensitiveness may be further increased by the addition of a certain proportion of sulphur, which is dissolved in bisulphide of carbon added to powdered asphalt.

Over a hundred years ago Joseph Niepce made the discovery that asphalt of Judæa, or "Jew's pitch," becomes insoluble upon exposure to light. He dissolved the asphalt in oil of lavender and spread it on metal plates which he exposed behind a drawing. The asphalt was then removed from the parts which had been protected from the light, and the metal was etched. This process Niepce termed heliogravure.

He next tried to produce photographs with asphalt-coated plates in a camera, and in 1827 took a photograph of Kew Church by this means, but owing to the comparative insensitivity of the asphalt coating, necessitating an enormously long exposure, the process proved useless for photographic purposes, though it is still employed in several photo-mechanical processes (*q.v.*). Light-sensitive asphalt for such processes is made by boiling raw Syrian asphalt with commercial cymene and dissolving in the mixture a certain quantity of sulphur flowers. After the formation of sulphuretted hydrogen has ceased, the cymene is distilled off and the remaining light-sensitive asphalt is then prepared for coating by solution in benzol.

ASTRONOMICAL PHOTOGRAPHY FOR AMATEURS

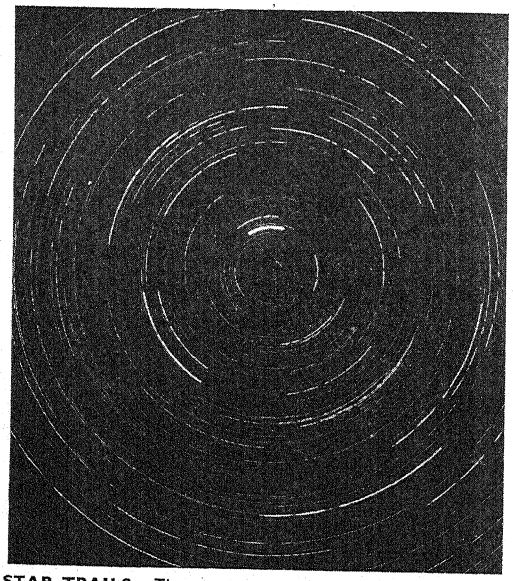
H. H. Waters, F.R.A.S.

Photography has played a very large part in mapping the heavens, in determining the motion of stars, and in aiding the observation of comets and meteors. This article, which is specially written for the amateur, shows how the camera can be effectively used for making interesting and useful photographic astronomical records without recourse to special and expensive equipment. The illustrations to this article are all by the author

In looking at the beautiful astronomical photographs published from time to time by the great observatories, the amateur photographer may, after wondering how they are produced, ask himself if there is anything to be done without costly apparatus. Whilst it must be admitted that some branches of astronomical photography are highly specialized and beyond the reach even of good amateur equipment, yet there is work to be done and interesting experiments can be made with apparatus of the "wooden box and tin can" type. The enthusiastic amateur should remember that possession of elaborate and beautiful apparatus does not necessarily mean increased or improved photographical output.

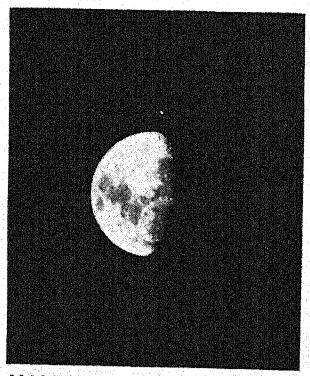
To the possessors of ordinary cameras, especially plate cameras with good lenses, I would recommend the following preliminary experiment:

Set your focus to infinity and your lens to its greatest aperture. On a clear, dark night point your camera to the pole of the heavens, fix it firmly, and expose a rapid plate for two hours. Develop your plate and you should have a picture like that at the top of the next page, the motion of the earth drawing out the star images into trails the brightness of which will vary according to the star's brightness. The camera will not *magnify* a star's image and the most powerful telescope will only make a faint star appear brighter.



STAR TRAILS. The circumpolar movements of stars have been recorded in this unusual photograph, the breaks in the trails being due to passing clouds. A fixed camera was used 180 *mins. exposure, f*4.8, 20-*in. focus lens*

With an ordinary camera an interesting series of pictures of a lunar eclipse can be taken. The addition of a telephoto lens giving an increase in the size of the image is valuable, but due regard must be given to the falling-off in illumination and to the importance of accurate focussing as described later on in this article. It may also be mentioned that for certain classes of work—for example, the delineation of large nebulous extensions—the small lens with its wide field is the only instrument which can be used, and it is more efficient than a large specialized photographic telescope. A home-made equatorial camera mounting, with worm-driven slow motion and a two-inch telescope for guiding, is not beyond the capabilities of a handy amateur.



HALF-MOON. This half-second exposure of the moon was taken with a 6-in. reflecting telescope, using primary focus

With this instrument several of the plates which illustrate this chapter were made, and it was only discarded after years of service in favour of a weight-driven type of mounting.

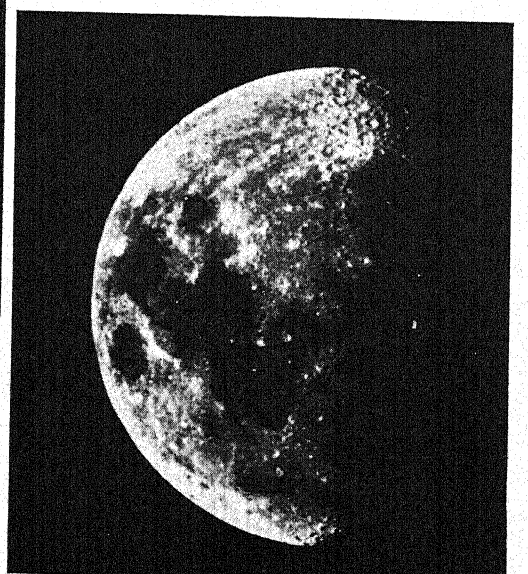
The application of photography to astronomy has increased so greatly in recent years that it has completely displaced visual observation in many branches of research. Daily photographic maps of the sun's disk are made at several observatories and the combined results are usually able to give a history of every outbreak of sunspots.

The spectrograph has practically supplanted the visual spectroscope, and with the advent of plates sensitive to the infra-red work has been further extended.

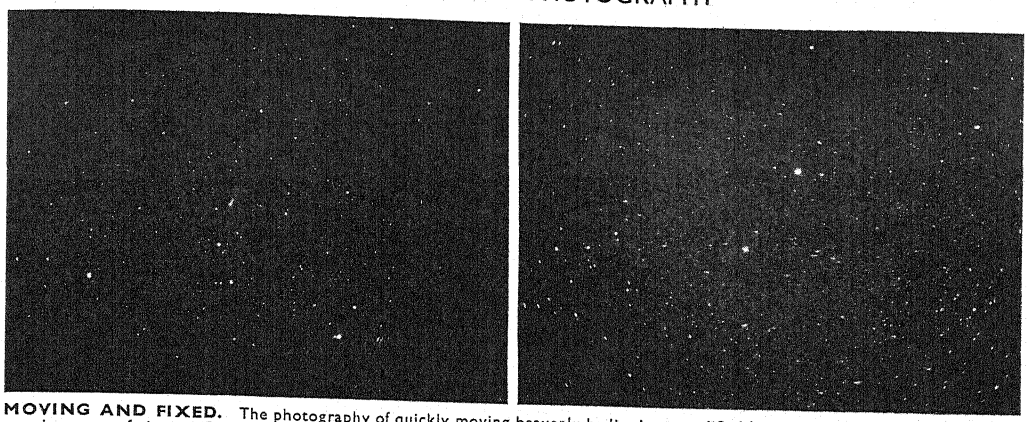
Most of the modern giant reflecting telescopes are employed almost entirely on photographic work either with or without a spectrograph, and, no doubt, the 200-inch reflector now under construction in California will be used as a gigantic camera.

In eclipse work the advantage of photography is obvious. A few precious minutes —sometimes only seconds—of totality are available, but during this period photographs can be taken which give a permanent record.

One of the most important properties of the photographic plate is its ability to store up the cumulative effect of light during long exposures. This has led to the discovery of stars and nebulae so faint that they could never be seen visually.



EYEPIECE ENLARGEMENT. The same phase of the moon as appears in the small picture on left is here seen taken with a 6-in. reflecting telescope, with the image enlarged with a low power eyepiece; exposure 5 secs.



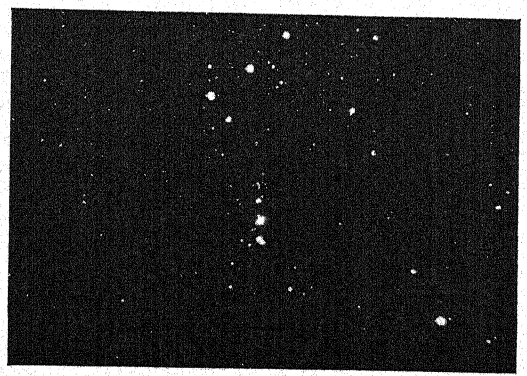
MOVING AND FIXED. The photography of quickly moving heavenly bodies is exemplified here with a view (left) of a comet, seen in centre of picture (5 mins., portrait lens, f3.3, 8¼-in. focus). On right, the bright stars in the centre are Castor and Pollux, in Gemini (30 mins., 2¼-in. portrait lens, 8¾-in. focus)

In considering the possibilities of photographic work for the amateur we can conveniently divide celestial objects into two groups: first, the Sun, Moon, and Planets; and, secondly, Stars, Clusters, Nebulae, Comets and Meteors.

As we are dealing with a wide variety of subjects, from the sun, with its intense light and heat, to the faint nebulae, it will be obvious that no single optical instrument will be suitable for all purposes, and, furthermore, as all the objects are in ceaseless motion with respect to the instrument, some means of counteracting this motion, *i.e.* the rotation of the earth, is necessary for all excepting instantaneous exposures.

For the sun, moon and planets we require an instrument of sufficient focal length to produce a disk large enough to show the details sought. This can sometimes be accomplished by enlarging the primary image by means of a low-power eyepiece.

Either a reflecting or a refracting telescope can be used for photography with a little adapting, but unless the object glass of the refracting telescope is of the photo-visual type, the visual and photographic foci will not be coincident and the photographic focus must either be found by trial, or a special filter, such as the Ilford "Astra," used in front of the plate.



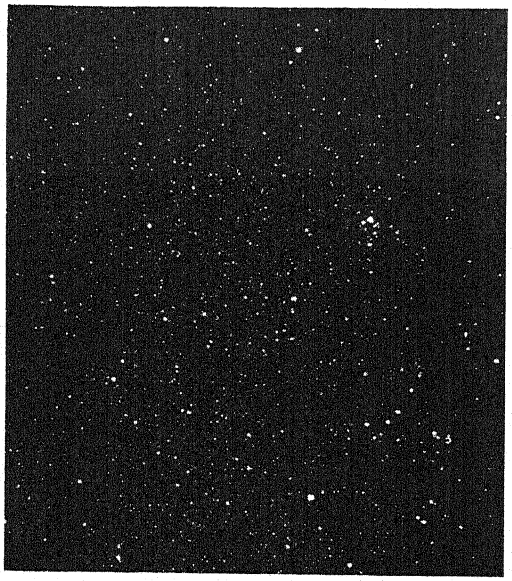
CONSTELLATION CHART. For the photography of constellations a wide field of view is necessary. This chart of the central portion of Orion was taken with a 60-min. exposure, portrait lens, f3.5, 13½-in. focus

A plate holder with a suitable adapter to fit the eyetube of the telescope will be necessary, and also a small box camera with suitable extension if an eyepiece or lens is used to enlarge the primary image. For the sun a rapid vibrationless shutter is necessary. This may be fitted to the adapter in front of the plate holder or in front of the object glass. A guiding telescope should be attached to the main telescope.

Photographs of the Moon

Photographs of the sun and moon can be taken with a telescope on an ordinary tripod stand. Even in the case of the moon the exposure need not exceed about half a second, and if the telescope is kept perfectly steady, no trace of movement should show on the negative.

In photographing the moon we must aim for sharp, bright images which will enlarge without loss of detail. The sun and moon, being approximately half a degree in diameter, will give a disk roughly half inch in diameter at the primary focus of an object glass or mirror of 5 ft. focal length. This is large enough to show a good amount of detail.



A GLIMPSE OF THE GALAXY. Above is a 45-min. exposure of a dense portion of the Milky Way, in the constellation Monoceros. For this comparatively small area a 4-in. lens with a 20-in. focus, was sufficient

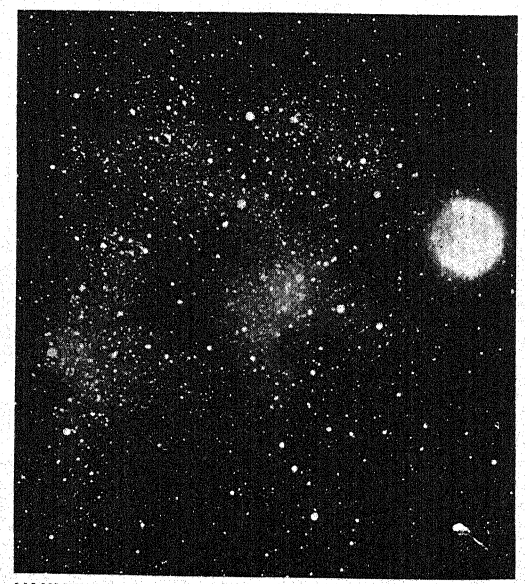
If a reflecting telescope is used the image must be very carefully focussed on a sheet of very fine ground glass; or, better still, a spoiled plate, using a focussing magnifier.

If the focussing screen is put into the actual plate holder and the slides drawn, and the focussing done with the plate holder in position, the focal point can be marked with a scratch on the adapter tube and the plate should come into accurate focus without further difficulty. If a refracting telescope is used, the best photographic focus must be found by trial exposures, scratches being made on the adapter tube to mark the position of each exposure. If a filter is used, the focus can be found visually in the manner described above. Do not spare trouble in obtaining the sharpest possible focus; a difference of 1 mm. on either side of the correct focus will produce a "fuzzy" image.

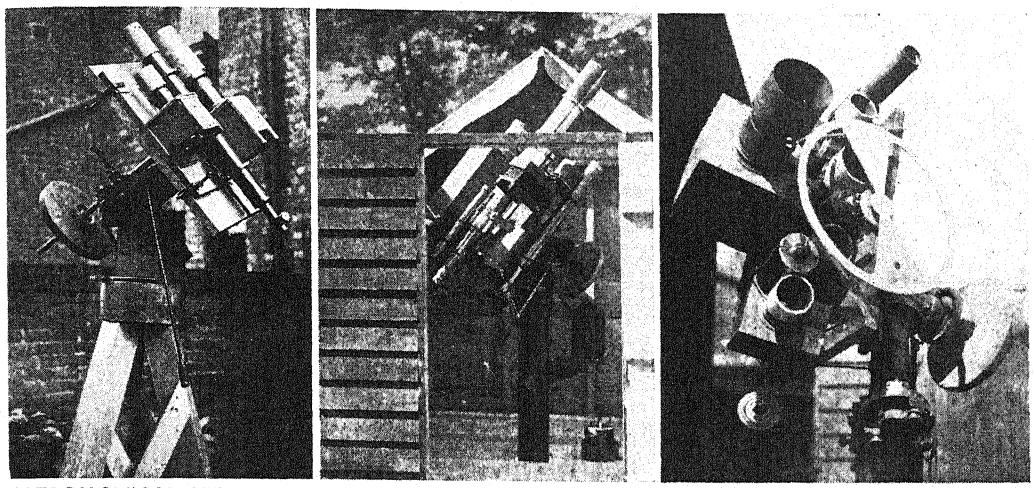
For the moon use the telescope at full aperture, with a plate of medium speed and fine grain. Correct exposure will vary with different instruments. Probably about half a second will be right with the moon at first quarter and a telescope with a focal aperture of about $f14$ to $f15$, with the plate at the primary focus. A light cardboard box lid on the object glass end of the telescope, or sufficiently large to cover the end of the tube of a reflector, makes a good cap for exposing, as it can be removed and replaced without shaking the instrument. Always make sure that the image of the moon is central on the plate before making the exposure by checking its position in the finder or guiding telescope.

A low-power eyepiece can be used to produce an enlarged image by projection into a small box camera. It is not, however, desirable to push the magnification beyond twice or three times the size of the primary image. The illumination falls off very rapidly, and the exposure is increased as the square of the magnification, and also the moon's movement and any vibration of the instrument, is magnified proportionately. It should be remembered that when the moon is full the illuminated area is very much brighter proportionately than when at first or last quarter. Observation shows that full moon is actually 8·7 times brighter than first quarter and 10 times brighter than at last quarter (Astrophysical Journal, Vol. 43, p. 47). So that exposure needs to be considerably reduced around the time of full moon.

It will also be found that owing to the unequal illumination of the moon's surface it is difficult to bring out the maximum detail over the whole disk on one negative.



UNIVERSE IN EMBRYO? The "America" nebula, in Cygnus; the large white spot on the right is the over-exposed image of the brightest star of the group, Alpha Cygni
90 mins., 4-in. lens of 20-in. focus



ASTRONOMICAL APPARATUS. Left is a home-made equatorial camera stand, with worm motion for driving by hand ; it bears two cameras and a 2-in. guiding telescope. Centre, a 4-in. telescope and two cameras on equatorial mounting with driving clock. Right, special battery of portrait lenses for photographing meteor trails ; a sector, driven by a small electric motor, is used to determine the meteor's velocity

Generally the terminator, *i.e.* the edge nearest to the unilluminated portion, will come out under-exposed, and this has the effect of giving the moon an age which does not correspond to the real age at the date of exposure. There seems no cure for this difficulty when photographing at the primary focus, but a more even illumination is generally obtained when using a low-power eyepiece to enlarge the image.

The writer's experience is that with a telescope of about 5 feet focal length, half a second is the maximum exposure which can be given with the instrument at rest, when photographing at the primary focus with a plate of about speed 100 H. & D. If, therefore, an eyepiece and box camera are used to enlarge the image, an equatorial mounting is essential. As the duration of the exposure is not likely to be more than, say, 10 seconds, a good hand slow motion is all that is necessary. The guiding telescope or finder should be fitted with a pair of cross wires in a fairly high power eyepiece. If one of the larger craters is centred on the cross wires it can be kept steadily in position after a little practice.

Photographing the Sun

To photograph the sun the aperture of the telescope should be cut down to about *f*60. A shutter preferably of the Compur type can be fitted centrally in a cap to fit over the object glass or mirror tube. A good brand of lantern plates will probably be found to give the best results and an exposure of about 1/40 second should be ample.

> *A word of warning. Never look at the sun even with the aperture of the telescope reduced without using a proper solar eyepiece or suncap, as serious damage to the eye is almost inevitable.*
>
> *Also remember that the heat generated at the primary focus is sufficient to burn a hole through the shutter of a wooden dark slide if the telescope is left directed to the sun for a minute or so.*

As there is plenty of light available the enlarging eyepiece and box camera are recommended. In using a box camera on the sun be sure that it is perfectly light-tight, especially where the tube of the eyepiece enters the box. It is difficult to give any rules for exposure ; a few trials will soon give a basis time, and considerable latitude either way will not seriously affect the results.

It is far more difficult to focus the sun than the moon. If there are some spots present they are a great help. All plates used for photographing the sun and moon should be thoroughly well backed.

Constellations, Nebulae and Comets

When it is desired to photograph a larger area of the sky, say the surrounding field of a variable star, or a large extended nebulosity, or to make a map of a constellation, the ordinary telescope is unsuitable owing to its small field, and we must use a photo-

graphic lens which not only gives the requisite wide field of view but also greater rapidity. If only one lens is available, it should have as large a linear aperture as possible, and as large an angular aperture as is consistent with good definition and covering power. For all round work a lens with an angular aperture of $f4$ to $f5$ will be most suitable, the larger the linear aperture the better. With an anastigmat of 12 to 15 inches focal length much beautiful work can be done. Small anastigmats of 5 inches to 7 inches focal length are very useful, and if one is available it should be mounted as a " check."

If the expense of the large anastigmat is considered prohibitive, recourse must be had to an old-fashioned portrait lens which can be obtained secondhand fairly cheaply.

Having obtained your lenses, mount them on cameras preferably of the home-made box form. The correct focal length for all celestial objects is, within very small limits, the infinity focus of the lens, so that only a small movement of the camera back is necessary for final adjustment and squaring on. See that your dark slide (the double book form is best) fits securely so that it cannot fall out if the camera has to be used upside down, and that the plates cannot move in the slides during a prolonged exposure.

The covering power of even the best lenses when used on the stars will be found very disappointing compared with their performance on ordinary terrestrial work, so that it is as well to use plates not larger than 5×4 inches for a lens of 12 to 15 inches focus and quarter plates for the smaller sizes.

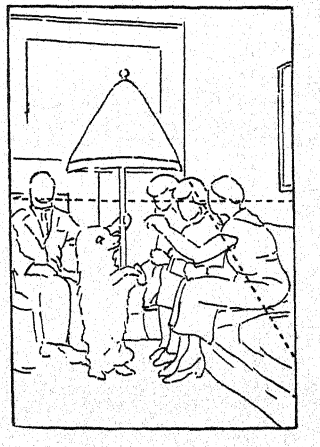
An equatorial mounting is absolutely essential, and although the writer has made exposures up to 90 minutes with hand slow motion which show practically no trace of " run off," a weight-driven clock or an electric motor to drive the guide telescope and camera will ensure comfort and longer exposures.

The approximate focus of the camera can be obtained by pointing it to the moon and using a ground glass screen and focussing magnifier. A trial plate may then be taken by pointing the camera to the pole of the heavens, clamping the telescope and allowing the stars to trail. If the trails are hard and sharp, especially at the centre of the field, the focus is probably very nearly correct. Then try a shot on a field containing some fairly bright stars. For guiding use an eyepiece of about 100 diameters on the telescope, fitted with a fairly coarse pair of cross wires, and put the guiding star out of focus so that it can easily be seen on the cross wires as a fairly large, bright disc. Before commencing an exposure, rotate the eyepiece so as to bring one of the cross wires exactly parallel to the stars' motion across the field. This will enable any error in declination to be detected, as the star will wander either above or below the wire. The other wire takes care of the movement in right ascension. The guiding star must be kept exactly central on the cross wires during the entire period of the exposure, and the results obtained depend very largely upon the accuracy with which this is done.

The appearance of star images on the negative should be round, small and sharp. At the edges of the plate, the brighter

[*Continued in page 137*]

Notes on Composition of " DOMESTIC INTERIOR "



At a glance this strikes one as a most pleasant and successful picture, and closer study abundantly confirms the impression. A few years ago such a subject was beyond the range of photography, as an exposure sufficiently short to arrest movement would have been inadequate for the production of a printable negative. Highly sensitive material, a large lens aperture and a powerful light have given a delightful and realistic range of tones.

Although it is called " Domestic Interior " it is not the room that matters; this forms a quiet and simple setting for the four people and the dog, and this group is the subject. The more people included in a group the greater the risk of some unsatisfactory feature. But here pose and expression are excellent in every case—not excluding the dog.

The triangle of the lamp shade suggests a base line along which the four heads are arranged; and if one side of the triangle is produced it will be seen that it gives roughly the line of inclination of the three figures on the right. This helps to focus attention on the dog, which occupies the strongest position in the picture-space. His upright posture is echoed by that of the man; and there are other strong verticals which give firmness and stability to a finely balanced picture. *W. L. F. W*



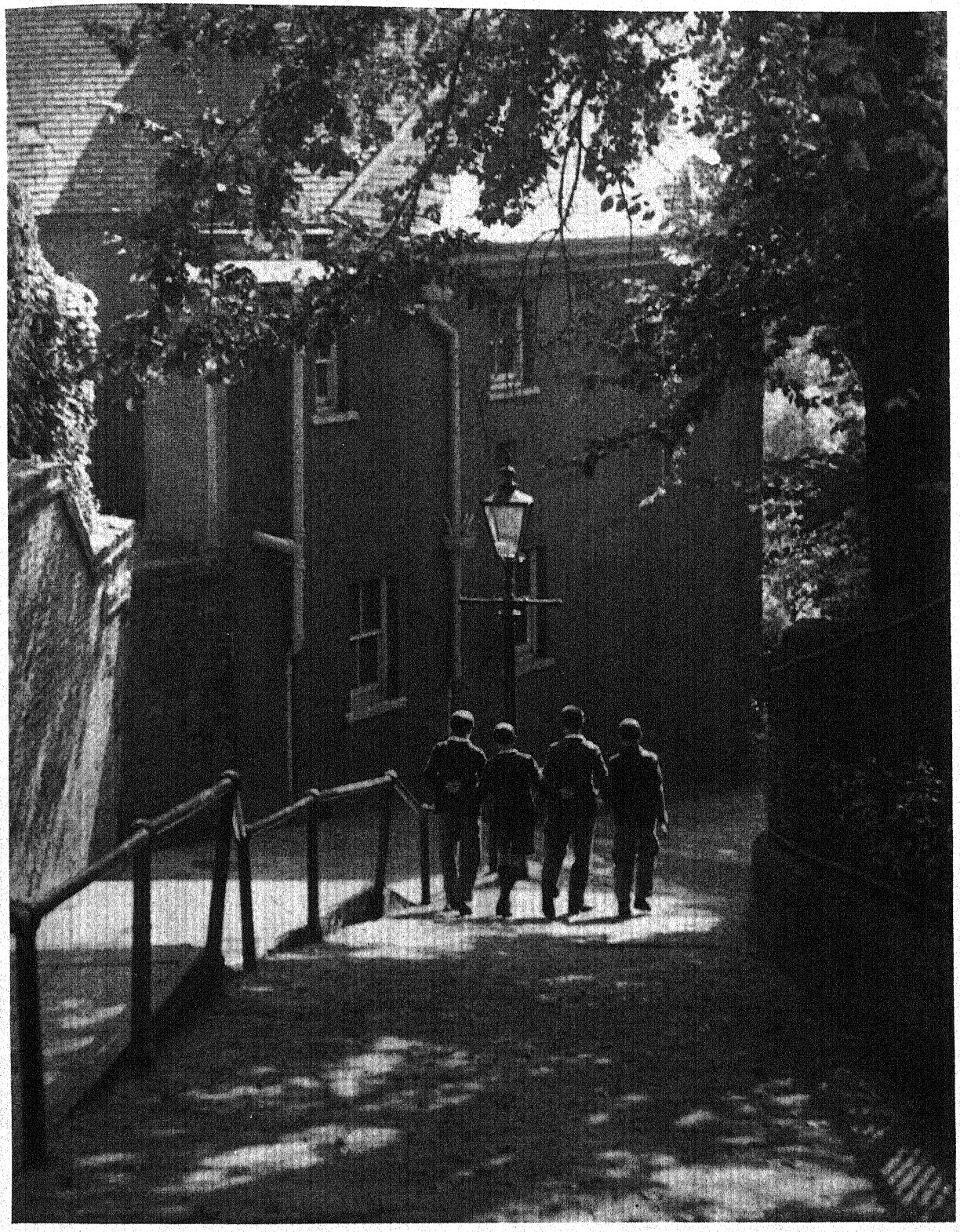
DOMESTIC INTERIOR Dr. Paul Wolff

Leica, 1/20 sec., f2, one Nitraphot lamp, s.s. pan. *See article on Artificial Lighting (pp. 119-126)*



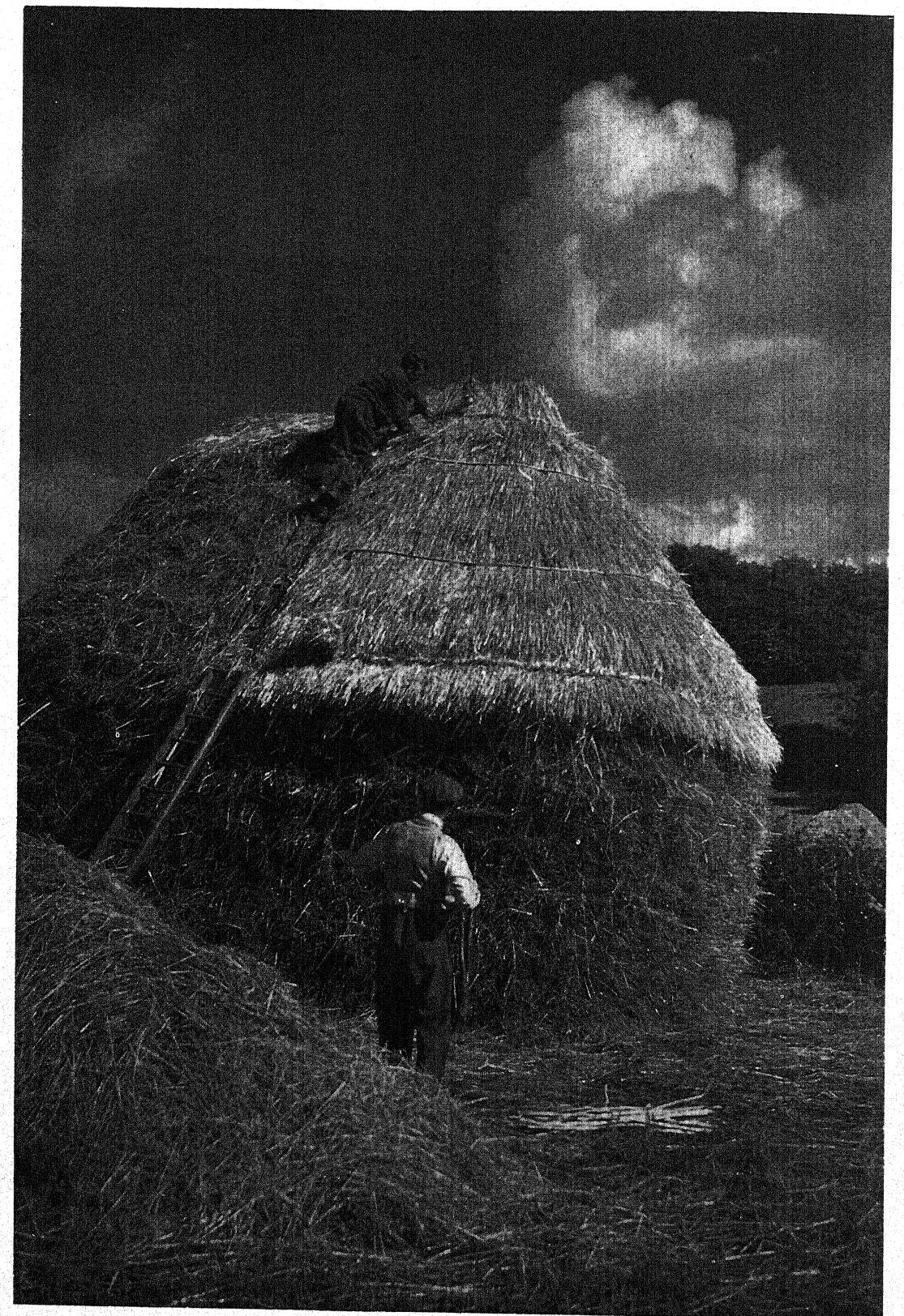
THE ARTIST

Rolleicord with Triotar lens ; taken on an April afternoon ; 1/25 sec., f11, Schleussner-Tempo-Gold film. An excellent example of back lighting



HOME FROM SCHOOL J. F. Cutler

Rolleicord camera, 1/25 sec., f5.6, Kodak pan. film. *See article on Back Lighting (p. 148)*



HARVEST END

Maurice H. Disney

Prize-winning photograph in "The Amateur Photographer" Competition. *See article Autumn with the Camera (pp. 139-144)*

star images will be drawn out into curious shapes. These can be used as an aid for accurately squaring on the plate by setting it so that the images are as nearly alike as possible in each corner. Do not be satisfied until your camera is accurately focussed and the plate very carefully squared on, and when this is done lock everything to avoid danger of movement. Fit your lens with a dew cap or tube of a length equal to about two diameters of the lens, painted dead-black inside. This will avoid a deposit of moisture on the lens during cold weather, which will completely ruin a night's work.

Meteor Showers. Very nice little maps of constellations can be made with an exposure of 30 minutes with a lens at *f*4.5, which will show many more stars than are visible to the naked eye. All parts of the Milky Way well repay photographic study, especially if an exposure of about an hour can be given. Do not miss an opportunity of photographing any small telescopic comets, as any early plates may be very valuable for determining position. It is also worth while to expose on the radiant point of some of the brighter meteor showers in the hope of catching a trail. The British Astronomical Association, to which all workers should belong, will furnish all particulars of current phenomena.

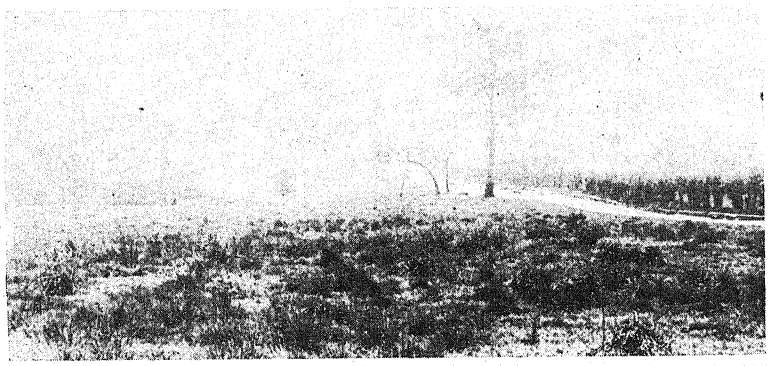
The plates for this branch of work should be the fastest obtainable, preference being given to that brand showing the least granularity, and, of course, they should always be backed.

Development Methods. The development of astronomical plates will present no difficulty to the worker who is already a photographer. A fairly strong contrasting developer is recommended. The time and temperature method has not been found very successful, as the conditions are exceptional. In developing pictures of the sun and moon, any tendency towards rapid flashing out should be avoided. This is easier to control with a solution which is slow in action. In developing plates of star fields a careful watch should be kept on the background of the plate, and development stopped before it becomes too black, otherwise faint images of stars and nebulae may be blotted out.

Any form of intensification should be avoided, as there is the risk that it might introduce detail which has no objective existence; but the contrast of faint objects can be increased by taking a positive from the negative by contact and making a fresh negative from the positive. We must, however, bear in mind that our object in astro-photography is to produce negatives of extreme sharpness and accuracy of detail. No spotting or retouching is allowed. The illustrations, which are from the author's own negatives, will give some idea of the possibilities of amateur equipment.

ATMOSPHERE and ATMOSPHERIC EFFECTS. The term "atmosphere" applied to a photograph may be used with two meanings. In the first place it may refer solely to the photographic representation of actual atmospheric haze or mist, and, secondly, it may be used to denote a variety of pictorial effects and subtle impressions of reality which may be introduced into a photograph by a clever worker as a result of taking advantage of certain conditions of light and shade at the time of making the exposure. It is in this latter and wider sense that the term is now more generally used, especially by pictorial photographers.

Atmospheric mist is represented in a photograph by the gradual indistinctness of the objects as they recede farther from the camera and fade into the distance. Such objects appear in light grey detailless tones. This variety of haze rendering in a photograph is best obtained by employing a rapid non-orthochromatic plate. An object or group of objects should be present in the foreground of the picture in order to contrast in distinctness with objects in receding planes. Under-exposure of such a view must be avoided and development should be carefully conducted, the aim being to obtain a soft, delicate negative in which the finest gradations of tone are preserved. Any blocking up of the high-lights of the subject by forced or prolonged development is fatal to the attainment of these direct atmospheric effects in the finished print. The negative should be printed or enlarged on to a paper of medium contrast, the successful print being of a luminous grey tone in which the increasing indistinctness of the receding planes is well marked. Photographs of the



The actual composition of a photograph may exert a great deal of influence upon the sense of atmosphere imparted by it. There is no atmosphere in a group portrait in which the individuals are arranged in a row. Nor, again, is there any atmosphere in a photograph of a row of houses taken " straight on " by means of a wide-angle lens. If, however, the individuals of the group were posed at varying distances from the camera, and if the row of houses were taken from an oblique viewpoint, the introduction of " atmosphere " into the photograph would become possible, since the objects of interest are not all confined to the one plane.



ELIMINATION OF HAZE. The atmosphere of autumn with its morning mists is amply present in the top view above, taken on an ultra-rapid ordinary plate. Below is the same view taken a moment later through a deep red colour-filter on to a panchromatic (red-sensitive) plate, with complete absence of haze and a clear view to the distance

Photos, J. F. Stirling

above nature are obtainable by reason of the fact that water particles in the air have the property of absorbing and scattering the blue-violet actinic rays of light which most affect the photographic emulsion.

It may, at times, be desired to eliminate all renderings of atmospheric haze or mist from a photograph. In many instances, this can be done by taking the photograph on an orthochromatic emulsion through a yellow filter, or, better still, by using a panchromatic (red-sensitive) plate or film in conjunction with a red filter. The yellow, orange and red rays of light travel with much less interference through the atmosphere.

Infra-red rays travel through the atmosphere with practically no absorption or dispersion at all. Thus, when a distant view is photographed through an infra-red light-filter on to an infra-red sensitive plate the heaviest haze can be penetrated successfully.

What may be termed a pictorial atmosphere as opposed to the mere photographic rendering of haze and mist may be introduced into a photograph by such means as a judicious photographing against the light, by taking advantage of the oblique rays of the sun when it is low in the sky, by various methods of selective focussing, whereby the principal object in the photograph is well defined whilst the secondary objects become more and more softened in focus as they pass into the background.

Atmosphere in a photograph may, of course, be made or marred by the type of paper upon which it is printed. An unduly contrasty paper which produces harsh black-and-white results will totally destroy atmosphere in a photograph. On the other hand, a paper which is too soft in contrast for the negative with which it is used will also suppress atmosphere. In the majority of instances a happy medium must be struck between these two extremes, and with an average well-produced negative, soft, yet full of tone gradation, a printing paper of a medium degree of contrast is most suitable.

—*J. F. STIRLING, M.Sc., A.I.C.*

AUTUMN WITH THE CAMERA

The efficiency of modern photographic equipment has increased the scope of the photographer to a surprising extent. Difficulties due to lighting and weather conditions are largely overcome, with the result that outdoor photography, as explained and exemplified in the following article, is now possible all the year round

See also Spring ; Summer ; and Winter, with the Camera

WHILE it is inevitable that a certain number of summer-time amateur photographers discard their cameras as autumn begins, it is a fact that many thousands more than ever before take a renewed interest in their hobby as the dull days and dark evenings approach. New subjects present themselves for treatment that could not be attempted in the past. Modern cameras and materials are responsible for this change of attitude. With the large-aperture " miniatures " and films of amazing speed and panchromatic quality, snapshots out of doors are now possible throughout the autumn and winter months, and indoor photography has become equally easy. Above all, the size of the majority of negatives today demands the use of an enlarger, and enlarging is essentially a job for the evenings at home.

Outdoor workers at this time of year should remember that the sunlight is much weaker as the year goes on, and, later in the day, yellow light predominates. This calls for panchromatic material, and the fact that snapshot work will not be so easy for the owner of a camera fitted with a lens with a small aperture is to a certain extent a blessing in disguise. Longer exposures are called for, and the camera must be held on a tripod or some other support. For this reason greater care will be devoted to the choice of subject and the exposure than would be the case if indiscriminate snapshotting were still as possible as during the bright days of summer.

Woodland Scenes

Among the many subjects that the amateur should attempt during the autumn with a view to picture-making are the woodlands that may be in his neighbourhood. Here the shafts of sunlight coming through the trees on a bright day make very effective pictorial compositions. The late afternoon will be found best for this work, and this is another reason why a tripod will be necessary, as fairly long exposures will be called for ; but the pictorial results—obtainable at no other time of year—will be worth this slight extra trouble.

The coming of the autumn, with the lessened power of the sun and lower temperature, brings points for the consideration of every amateur photographer, particularly those who have only started during the year and have founded their knowledge, as is often the case, on the photographs they have taken during the summer months.

Less Light—More Speed

Many photographers use plates and films of medium speed for summer work. Autumn calls for more speed, and it is the custom of a great number of serious workers to change over to material of super speed. If the photographer doubts his ability to use such material through the greater care that must be exercised with regard to dark-room manipulation, it will mean longer exposures, and possibly a tripod will be necessary if the subjects contain a large proportion of shadow.

In all cases very great care must be taken not to under-expose, as some of the best subjects at this time of the year contain a large proportion of shadow.

Some of the successful summer subjects, if available, may be even more attractive under autumnal lighting conditions, and often display startling differences. Landscape subjects and the like will be found to be very different, through the lower position of the sun ; while still greater differences will be found in the case of architectural subjects. Everywhere there is a difference in the lighting, the contrasts are less sharp, and the sunshine has a softer character.

Those photographers who employ tank development, including the growing army of small-camera users, will not need to be reminded of the importance of ensuring that solutions are of normal temperature. A low temperature during the night will cause a definite fall in temperature also of developers, etc., while the same result will be noted

on a cold, wet evening, and at various other times.

Care must be taken not only to allow for an increased time of development through the lower temperature, but also to see that the solution is not too cold for effective working. Hydroquinone, for example, loses activity at lower temperatures than 50° F. It is a good custom, although not general, to test the developer when making bromide prints at this season of the year. Too cold a developer may result in prints which lack depth and vigour, and also have poor colour.

With regard to this question of temperature, it is well to point out that the best course to pursue is to keep the solutions, and the water that is to be used for making up developers, in a warm room for some hours prior to use, or to adopt some means of warming the dark-room. (*See* Developing.)



SUNSPLASH AND SHADOWS. The long, slanting rays of the sun give a particular charm to outdoor photographs taken in the autumn, and provide a change from the usual summer-time atmosphere of so many pictures. The lighting conditions, however, make material of super speed essential

Photo, D. Swaine

Effect of Damp. At this time of the year the photographer will also have to be on his guard against the several possible causes of defective negatives through damp or atmospheric conditions. It is very necessary that apparatus should be kept dry, especially lenses. It is also necessary to exercise care in order to safeguard plates and films, as well as printing papers, from the same injurious influence.



AUTUMN MORNING. The ethereal autumn morning mist provides a pleasing background in garden pictures, and ultra-rapid material makes simple the correct rendering of foliage tints

Photo, Clarence Ponting; Ensign Sanderson Camera, ¼ sec. at f8

Cold weather conditions may cause the formation of moisture on the lens, and especially if the latter is taken from a cold atmosphere into a warmer one. Contact with the hand, when setting the stop or the shutter, may for a few seconds have the same effect; and if such a deposit of

moisture is not removed it will mean negatives of poor definition, if not a complete blur.

Regular inspection of the glass surfaces is therefore essential, with careful cleaning should this be necessary. The same applies to lenses and condensers of enlarging apparatus kept in cold dark-rooms.

AUTUMN COLOUR PHOTOGRAPHS

With the countryside aglow with bright colours autumn is an ideal time for the photographer who utilizes the several excellent colour films that are now available. Here we deal with this form of picture-making from the point of view of those who are new to the process

Autumn provides many opportunities to those photographers who are using the new colour films, for their exposures may be made upon the gloriously tinted foliage of autumn. There is no doubt that these subjects are ideal for colour photography, but there are one or two important points for the tyro to note.

The beginner at colour photography is naturally attracted by the wide vistas of varied colouring, which seem to provide perfect subjects. This is not the case; far more effective colour pictures will be made over comparatively small areas.

The best subjects for colour photography are those where a few brilliant colours stand out in vivid contrast against others, such as the dark greens of firs. It is not enough to reproduce one colour—several hues are necessary.

The colour film, as is well known, having a rather smaller margin of latitude than that allowed by ordinary plates and films, those subjects having great lighting contrasts should be avoided. The contrasty subject fails not so much by reason of limitations in the technique of the medium, but because the deeper shadows show very little colour.

On the other hand, there are cases where one or two colours stand out vividly against a dark background; that the background is in shadow will assist in making for the brilliancy of the colours which form the subject.

The lighting, and its effect on colour, is very important. The best results will be obtained when the lighting is soft in character. This gives brilliancy of colour without the strong contrasts that the colour photographer should avoid. The lighting conditions can make or mar a subject. Some of the best effects will be secured, both with regard to brilliancy and accuracy, when the sun is shining through light clouds.

Time and Conditions. The best time of the day is the early morning or late afternoon. The lighting conditions are softer, there is less shadow in the case of open subjects, through the lower position of the



THE APPLE CROP. In his search for suitable autumn subjects the photographer should not overlook the farm and orchard, where the abundance of rich tones offers many opportunities for striking colour pictures

Photo, Associated Press

sun, and the colour rendering is better than under the most brilliant sunshine conditions.

Wind is a troublesome factor that the autumn colour worker has to contend with, but early and late in the day this is often less troublesome.

The new colour films are very successful with the rendering of cloud forms, which can be such an attractive feature of the landscape at this season. Provided that the subject is not too contrasty, which may entail the loss of the sky through the longer exposure required for the shadow, it is possible to render the sky and cloud forms very convincingly. Golden foliage, green grass, with a blue sky, make a combination that the worker will find it hard to resist.

The autumn colour worker should be very careful with regard to the exposure and the only safe course is to use an exposure meter, as the lighting conditions are so deceptive that it is easy for a photographer of experience to go wrong.

A tripod will be necessary for most subjects because, while the modern films are faster than the materials of a few years ago, exposures will run to a second or more.

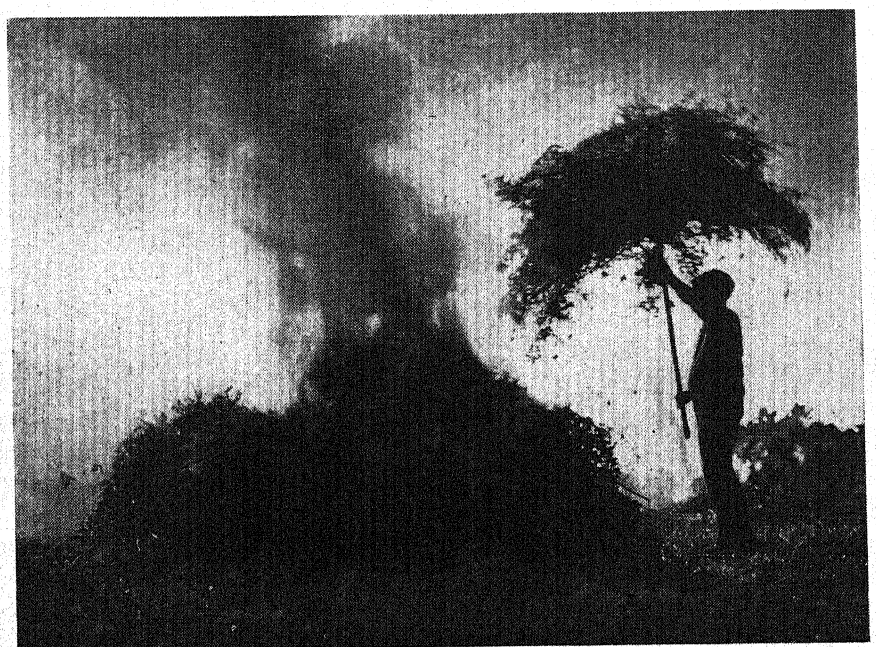
The colour worker should be warned against making exposures upon very dull days, as it is then almost impossible to secure brilliancy of colouring, no matter how long the exposure. It must be realized that brilliancy of colouring depends in no small measure upon good lighting conditions.

AUTUMN LIGHTING FOR CINEMATOGRAPHY

The keen amateur cinematographer is reluctant to put aside his camera when the bright days have passed. Here he is told how to "shoot" successfully in the more difficult lighting conditions that prevail in autumn

Shooting in the open air has now been divested of a great element of uncertainty by the introduction of the inexpensive electric photometer. Exposures which formerly were somewhat difficult to calculate can now be read off with extreme accuracy; nor is there much doubt that interior activities will continue to be put off whilst working out of doors can be made to yield satisfying results without the use of expensive illuminants.

This does not mean, however, that autumn shooting is going to prove simplicity in itself, for it is well known that the "natural" filtering which occurs at this time of the year is prone to result in unusual renderings. These can generally be corrected by the considered use of filters; but there are other difficulties not so easily appreciated, and these are usually of greater importance.



OCTOBER BONFIRE. Figure subjects, such as the labourer in this photograph, can be included as an effective supplement to an outdoor autumn scene

Photo, D. Swaine

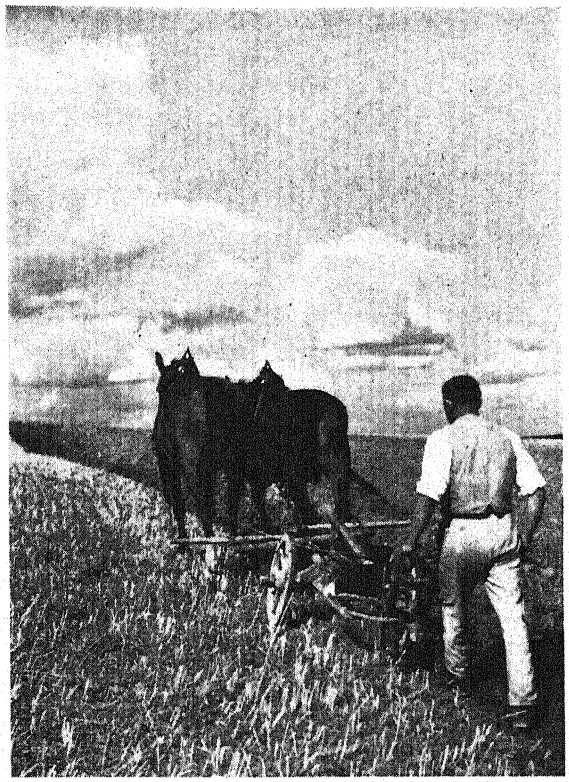
Angle of Lighting. Successful cameramen frequently exploit the "Rembrandt" lighting, or that arrangement whereby the sun is located at an angle of 45° with the face of the set. Modelling and some detail on the shadow

side are achieved with the aid of matt reflectors situated on the opposite side of the set.

In the autumn however, the low position of the sun makes for a greater diffusion of light—and here the effect of using reflectors is rather to lessen the range of tones. Indeed, assuming the use of a small set, only a pair or so of efficient reflectors could destroy the deep shadows to such an extent that the scene would appear flat and lifeless.

To overcome this it is recommended to use only *small* reflectors—mainly to emphasize major action proceeding on the set. Thus, if it were intended to show a man begging on the streets, the small reflectors would be used as close up as possible to make a high-light of his matches, etc.

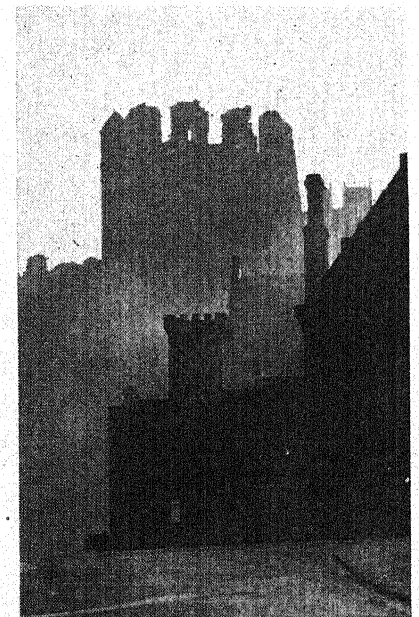
In larger sets a great variety of tones from high-lights to deep umbra can be secured by using a *large* reflector, *contre jour*, some distance behind the set. The effect here is not that of familiar back lighting, but is to counteract in the upper part of the picture a tendency of the low sun to cause drabness of image.



TRUE RENDERING. The fine tonal qualities of this photograph taken with a Leica camera convey a perfect impression of an autumnal atmosphere. It has been obtained largely by careful attention to exposure

Copyright, E. Leitz

Focus and Filters. It will be appreciated, that as autumn progresses the need for " neutral density " filters will become smaller and smaller—nor will it long be possible to stop down to the smaller apertures in the lens diaphragm. Now, a small aperture means a deep field of focus, and in a deep field of focus minor errors affecting the making of distance adjustments are not likely to show up. But a large aperture—the use of which is imperative with the reduced intensity of daylight—means a greatly restricted field and a consequent need for the exercise of care in setting the distance flange.



MIST FOR EFFECT. A pronounced seasonal effect is given to this photograph by the background which is shrouded in light

Photo M. W. Brampton

Many amateurs seldom progress beyond the use of filters for cutting down the blue intensity of daylight. The need in autumn is for a screen that will cut out some of the warmer colours in addition to the blue, and for this purpose the use of a deep green filter of the Ilford " Gamma " type is strongly to be advocated. An excellent alternative practice is to use super-panchromatic film and no screen whatever.

Inexpert workers possessing orange or amber screens should certainly avoid using them except

in the summer—for, apart from the important question of rendering, some of these filters have multiplying factors and other qualities that make their effective use quite an art in itself.

Finally, filter work in the autumn calls for the use of an efficient lens hood employed *over* the filter. All the Dallmeyer and certain other ranges are threaded to permit of this arrangement; while in difficult cases a suitable hood may be improvised from insulating black tape—a small piece of which may usefully be carried rolled up in the camera case or in the pocket wallet.—*S. E. L. Moir.*

BACK FOCUS. The so-called "back focus" of a lens is quite different from the focal length marked on the lens. The point from which the focal length of a lens has to be measured may lie in one of the glasses, somewhere within the lens mount, or, in the case of telephoto lenses, outside (and in front of) the whole lens system. The so-called back focus is the distance from the back surface of the lens to the focal plane, when the lens is focussed for infinity. A 12-inch telephoto lens may have its back element only 6 inches or so from the focal plane; a 12-inch single lens would probably have as much as 12 inches back focus.

BACKGROUNDS: THEIR PURPOSE AND CHOICE

***David Charles*, F.R.P.S.**

Author of 'Commercial Photography,' 'Brighter Photography'

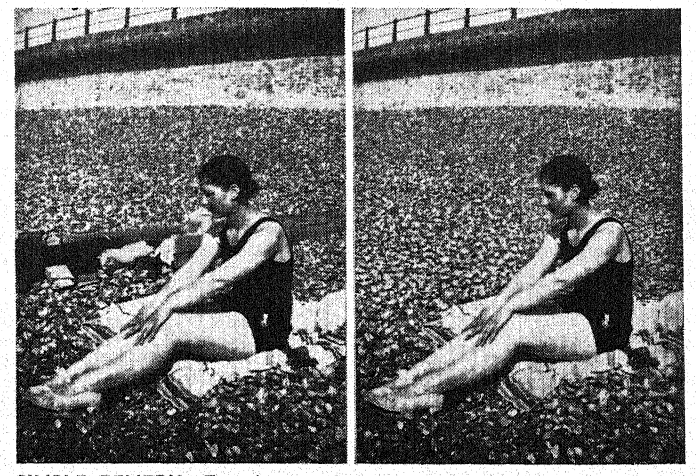
The selection of the background setting in a photograph is one of the many points that must be carefully considered by the photographer who is intent on perfecting his art. While experiment and experience are the main factors that count, the following article by an expert reveals the general principles, and will prove of value to the beginner

A BACKGROUND is the setting before which the subject of a photograph is disposed. It may consist of an actual scene, or of a painted sheet or of properties; or again a background may be composed of light-and-shade effects produced by projection. Further varieties of background can be introduced into photographs after taking them, by fortuitous means, such as by combination photography or by employing graphic art work. The matter which is photographed behind the subject or applied around it, and also the effect produced in or upon the print, are all called backgrounds.

Although not necessarily directly opposed in meaning to the cognate term "foreground," an outdoor background consisting of actual "distance" frequently provides not only very pleasing results, but also effectively solves several technical and practical problems, as will be explained.

When a fairly distant view of suitable character is not available as a background, nothing is more objectionable than a crude makeshift. Attempts to imitate the plain background of the professional studio by hanging a blanket or the like over a screen usually result in ugly creases and folds, and plain backgrounds of fabric should be stretched taut, or, better still, should consist of distempered beaver-board or the like, without visible joins.

In selecting a "natural" background it is desirable, so far as is practicable, to avoid



SIMPLE REMEDY. Two photographs showing how background details can spoil the balance of a picture. The obtrusive objects which mar the composition in the left picture have been removed by an artist in the improved photograph on the right



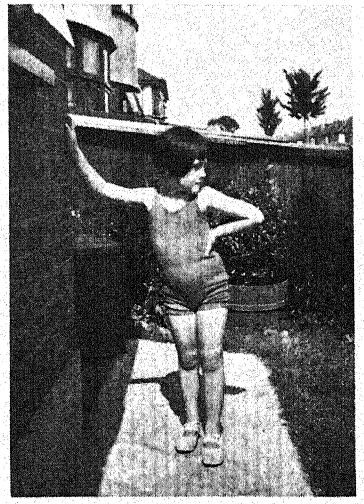


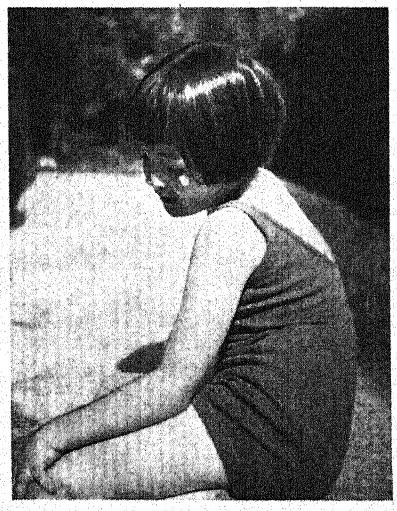
OBTRUSIVE AND UNOBTRUSIVE. Left, how a crowded background can completely ruin a picture, the figures in the foreground being lost against the over-emphasized details behind. Right, a seashore picture in which the background is softly defined and therefore of value

such areas as contain definite streaks, patches or spots. Tree-trunks and fences exemplify the first, most seaside beaches and back gardens abound with the second; while brick walls, privet hedges and nearly all patterned wallpapers provide ample examples of the third variety of objectionable backgrounds. The purpose of a background is to enhance the subject. The background should not call attention to itself more forcibly than does the subject, but on the contrary it should always be in every way harmonious yet subservient to the latter. The background must neither spoil nor steal the picture by obvious faults on the one hand or by over-emphasis on the other hand. Even in ambitious compositions which are intended to strike the modern note of sophistication, and in which quite extraordinary backgrounds are employed, it will be noted that the latter are softer both in focus and also in gradation of tones than the main subject.

Because of their tendency to define the background almost as sharply as the subject, use of either the miniature camera or the popular box camera calls for greater discrimination in the disposition of subject against background than when a long-focus lens of large stop-diameter is used. With the latter an imperfect and fairly distant background can often be blurred almost out of recognition. In referring to the miniature camera it is not forgotten that it is adapted to the use of fairly long-focus lenses (*q.v.*), the longest of which give slightly less diffusion of background than will an 8- or 10-inch lens working at *f*4.5.

Similar differentiation between sharp subjects and softly-defined background is





HARSH AND HARMONIOUS. Photographs taken in the garden are easily spoilt by the harsh, ugly lines of a fence or wall appearing in the background (left). Right, correct disposition of the subject, with the same background suitably subdued

Photos, David Charles

encouraged by keeping as much actual distance between them as can be conveniently contrived. A full-length figure, for instance, should have, if possible, considerably greater distance between it and the background than is required for a close-up portrait. When a suitable expanse of real and considerable distance is available as a background, the subject will appear to stand out from it with any type of apparatus.



DIFFUSED. By using a large diameter lens the background can be diffused even when it is close to the subject

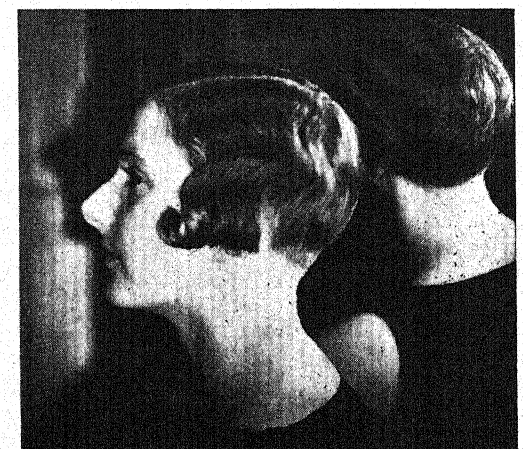
Photo, David Charles

Backgrounds for Groups. For a simple plain background out of doors, suited to either single figures or groups of people, it is difficult to find anything better than a hill or bank which slopes upwards and away. Sea and sky should be used in similar fashion with great caution, first because of the large area of intense glare which they set up inside the camera, and which tends to dull the image; and, secondly, because if faces photographed against them are sun-browned and the negative is the least under-exposed, the effect tends to be negroid. By careful observation of the lighting on the faces, turning them this way or that, together with the intelligent use of filtered panchromatics (colour sensitive films or plates used with yellow filters), considerable control may be effected between dark-toned faces against an almost white ground, to brightly-lit faces against a medium grey ground, using the same models in the same spot.

Simple Indoor Devices. Indoors, of course, it becomes practicable to effect considerably greater control over the effect of a background than out of doors. Even one single plain square of canvas or wallboard distempered in a light tint of grey can be made to provide an extraordinary diversity. With the subject, whether portrait or still life, lit in normal fashion this kind of background a yard or so behind the subject will produce a tone in the result of about its "natural" depth. Canted towards the side from which the main light comes, it will appear, and also photograph, lighter in tone. Some extra light directed upon the background only, especially if it be from a spotlight, can be made to turn it into a plain white ground, or into one graduated in tone by allowing the extra light to illuminate it unevenly.

By placing a support of some convenient form somewhere between the source of extra light and the background, on which cut-out pieces of cardboard are pinned, the shadows of the latter can be made to form all sorts of interesting shadings upon the background. These shadow shapes can be made abrupt or diffused and arranged to blend or to contrast with the outlines of the subject.

Similarly, the same grey background canted towards the "shadow side" of the room, or taken farther away from the subject (or both at the same time), will assume, and so produce in the result, a tone up to many shades darker. Any other form



REFLECTED. An unconventional background produced by a reflection in a mirror and a shadowed silhouette

Photo, David Charles

of indoor background can be controlled in the same manner. Curtain materials of "repeat" patterns are seldom suitable as backgrounds, and even plain materials which hang well should be used with caution to avoid the folds producing dark vertical lines of rather definite shadow. In fact, any background having vertical lines, even though it be a genuine old fireplace or window-seat, and seemingly an ideal setting for a portrait, calls for particular care in having the back of the camera truly perpendicular. Even though the subject of a portrait may call for a downward sloping camera, as, in fact, most do, it is extremely bad craftsmanship to reproduce oak panels wider at their tops than below, or an "inglenook" as falling over.



EFFECTS WITH A WALLBOARD. The same plain background consisting of a wallboard or square of canvas can be arranged to give different effects by varying its angle and that of the lighting, as shown here

Photo, David Charles

Special Background 'Sets.' In advertising studios, as well as in cinematograph studios, both professional and amateur, background "sets" are employed. These consist of sectional constructions, by means of which interiors and exteriors of many kinds can be simulated. In these the same remarks as to the necessity for adhering to perpendicularity apply, except when an "angle shot" is made deliberately and with full expectation and pre-knowledge of the effect. The decided slope so obtained does not pretend to be an eye-level view, and so the effect is interesting instead of being unnatural (*see* Angle Shots). Background sets composed of rectangular and cylindrical blocks, together with sections of arches and the like, are built up into a variety of conventional (and unconventional) forms, among which draperies and trailing sprays of artificial plants are employed with considerable beauty and diversity of effect by some photographic artists.

Rules to Remember. In experimenting with unconventional or unfamiliar background settings, it is desirable to remember that whatever the extent of untruth to life flights of fancy may direct, yet there are always some basic laws of natural science which may not be transgressed. This remark is prompted by such an actual instance as a picture of a lady sitting under a full moon, the light from which was apparently darkening one side of her face, the lighter side of which was turned away from the moon, towards a dark forest. In another case an equally beautiful girl had apparently passed her fingers miraculously through the panes of a leaded glass window, and was casually grasping the metal framing; nor did her expression suggest that she felt any pain. If a model, again, is to be represented as cooking upon a stove on which a kettle is also presumably boiling, turn the spout away from her face and remove that valuable engraving from the background wall.

Retouching Methods. Objectionable backgrounds are often removed from photographs, mainly of commercial subjects, by painting upon the negative with opaque water-colour up to the outline of the subject. The background then prints pure white. In other cases a background is painted or sprayed with an air-brush on to the print, the result being afterwards copied. Subjects with clear outline are frequently treated by cutting out a print, which is then mounted upon a print of the desired background.

Many effects, sometimes simple and sometimes apparently wonderful, are obtained

in this manner, although usually some assistance of handwork with brush or spray-gun is called for to complete the illusion.

The method known as rear-projection of backgrounds is now quite commonly employed in cinematograph studios, but much less often in still photographic establishments. This method consists of projecting on to a translucent background from the farther side a positive transparency of the desired scene or effect by means of an optical lantern. The subject itself is lit and photographed in the ordinary way, and appears as though actually in the surroundings of the projected view. In many advertising studios, however, clever retouchers are employed who actually turn a plain grey background in a negative into a scene or design appropriate to the subject. They do this by means of pencil and scraping knife, and both plates and films with matt surface are manufactured specially for their benefit.

BACKING. The coating which is given to the backs of plates and films to prevent halation (*q.v.*). The side of the plate or film opposite to the emulsion is coated with light-absorbing dyes which take up any rays of light which have passed through the emulsion. This backing, which has served its purpose once the exposure has been made, is removed by the developer during the processing. *See* Emulsion ; Film ; Plate.

BACK LIGHTING. Back lighting, where photographs are taken with the sun almost shining into the lens of the camera, requires certain precautions, but with care and a degree of practical experience the method presents a means of obtaining very striking and highly artistic pictures. It is also known as *contre jour* work.

In every case great care must be taken not to allow direct sunshine to fall on the camera lens, or flare spots may spoil the negative, quite apart from general fog and reflected light from inside portions of the camera. Many lens hoods sold for general use are not long enough to be effective, and if the hood is wrongly constructed it is possible to obtain reflection from the inside of the hood itself. Direct sunshine can often be shaded off the lens by hand, but the lens itself should never be subjected to the



BACK LIGHTING FOR ARCHITECTURE. The artistic qualities of this photograph, taken at Shere, Surrey, are largely due to the back lighting which endows the whole scene with breadth and relief. Back lighting, in which the camera is turned towards the source of the light, necessitates some form of lens hood, as explained in this and the opposite page

Photo, Bernard Alfieri, Jr.

direct rays of the sun, whilst with focal plane shutters and the lens set at infinity it is even possible to burn a hole through the blind and set the film alight. With due care there is no difficulty in photographing very nearly into the sun, and a funnel bent up out of black paper, and held to an existing short lens hood with an elastic band, can be successfully employed as a temporary measure.

General Effects. When a real beginner obtains a first camera it is usually suggested that photographs should be taken with the sun behind the camera, which is the safest and quite the most uninteresting position for lighting any subject, the results being flat and devoid of modelling. As the position of the camera is turned towards the source of light, shadows appear, giving a third-dimensional quality to the subject, until when beyond a right angle to the light source the shadow portions lose detail, and the contrast increases until almost a silhouette effect is obtained; but at the same time a bright halo of light forms round any outstanding portion of the subject, while forward shadows are available and will be found a great help in planning a good composition.



HALO EFFECT. An outdoor snap in which a pleasing halo effect has been secured by back lighting
Photo, Bernard Alfieri, Jr.; f5.6, 1/50 sec., s.s. pan. film

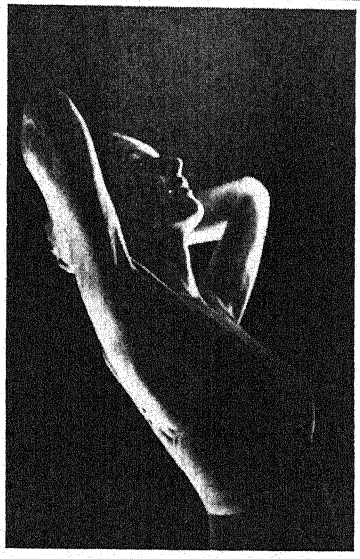


FIGURE STUDY. In this indoor photograph the strong outline effect was obtained by using two lights partly behind the figure
Photo, Bernard Alfieri, Jr.

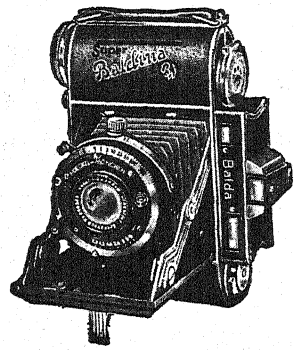
Landscapes. In landscape work back lighting is often a method of turning a very ordinary subject into a picture of high artistic merit. No attempt should be made to try to obtain intricate detail in the silhouetted portions; they can be so arranged that, as a black patch, they will show up in great contrast the more interesting portion of the subject, while smoke and other factors in a picture may become almost luminous in comparison.

Figure Studies and Portraits. Figure studies and portraits lend themselves to these methods, though it is often an advantage to employ a reflector to lighten the darkest portions of a face. With care, a brilliant outline to the figure or face can be arranged with just enough light catching the important lines to present a photograph which will have the merit of an impression rather than a detail survey of the features, and present a picture that is full of life and atmosphere. Back-lighting effects are by no means confined to sunshine; and indoors, where the lamps can be shaded from the camera, it is a much easier proposition.—*Bernard Alfieri, Jr.*

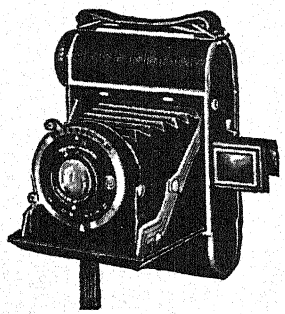
BALDA. Balda cameras, of German origin, are built on orthodox roll-film camera lines and all are of compact, folding design. The "Baldina" is a miniature instrument and takes a 35-mm. film. It has a parallax correcting tubular view-finder and is equipped with an automatic exposure counter. This

camera is available with three different types of lens: one is a Meyer Trioplan *f*3.5, the second is a Meyer Trioplan *f*2.9, and another alternative is a Xenon *f*2. The "Baldina" measures 5 × $3\frac{1}{4}$ × $1\frac{1}{16}$ in.

Another model of this make is known as the "Super Baldina." This takes pictures of 24 × 36 mm., on standard cine films. Equipment includes a built-in coupled range-finder, a tubular view-finder with a special adjustment whereby the optical axes of the camera lens and that of the view-finder are both directed to the same point on which the sight is set. Another feature is the automatic counting and film-locking device which operates after each exposure. The lenses fitted are a Meyer Trioplan *f*2.9, a Zeiss Tessar *f*2.8, or a Schneider Xenon. The dimensions are 5 × $3\frac{1}{4}$ × $1\frac{5}{8}$ in., and the weight is 17 ozs.



'SUPER BALDINA' camera which takes 36-mm. film. It has a built-in range-finder



'BALDAX' camera with direct vision view-finder and self-erecting front

Other Balda cameras of similar design are the "Baldi," the "Baldax" and "Baldaxette." The first takes pictures of $1\frac{3}{16}$ × $1\frac{9}{16}$ in., 16 exposures being possible on the standard eight-exposure V.P. roll-film. The front of this model is of the self-erecting type, with folding bellows and spring-extended struts.

Six alternative lens-shutter combinations are available, ranging from a Vidanar *f*4.5 with Vario shutter to a Meyer Trioplan *f*2.9 with Compur Rapid shutter.

The "Baldax" takes 16 pictures of $1\frac{5}{8}$ × $2\frac{1}{4}$ in. on standard $2\frac{1}{4}$ × $3\frac{1}{4}$ in. roll-film. As with the "Baldi," six different types of lens and shutter are available with this model, which is fitted with a direct vision view-finder. The dimensions are $1\frac{1}{2}$ × $3\frac{1}{4}$ × $5\frac{1}{4}$ in., and the weight is 1 lb. 1 oz. The "Baldaxette" is a high-grade camera with a self-erecting front, helical lens mount, built-in split-field range-finder, and other distinguishing features. The lens fitted is a Meyer Trioplan *f*2.9, and it has a delayed action Compur shutter (1/2,500 sec.). It is designed to take 16 pictures on standard eight-exposure $2\frac{1}{4}$ × $3\frac{1}{4}$-in. roll-film. "Baldaxette II" is similar in design, but takes 12 pictures $2\frac{1}{4}$ × $2\frac{1}{4}$ in. on $2\frac{1}{4}$ × $3\frac{1}{4}$-in. eight-exposure film.

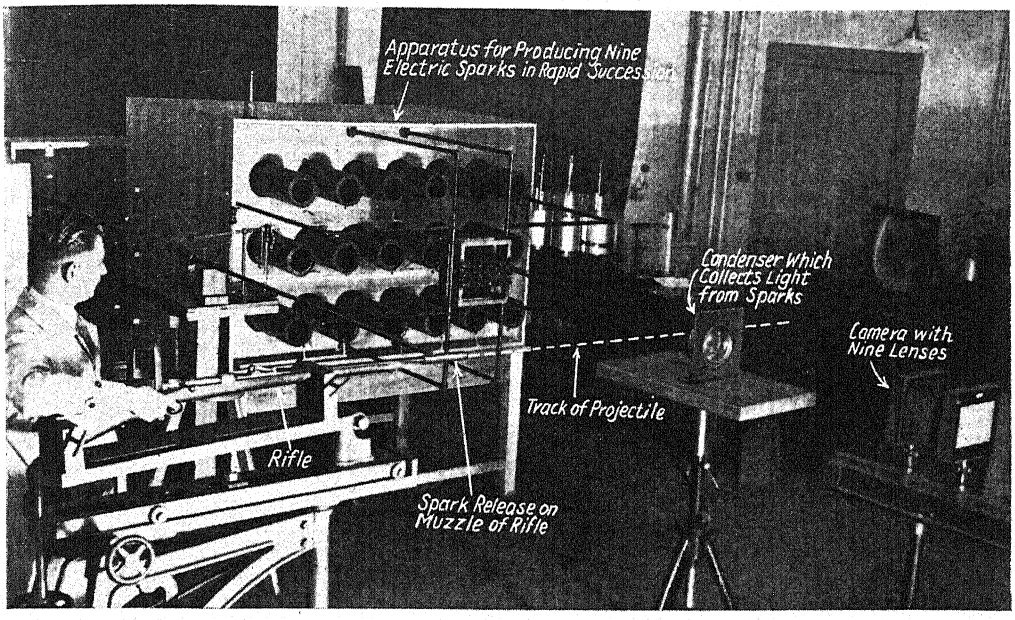
BALLISTIC PHOTOGRAPHY AND ITS APPLICATIONS

The portrayal of bullets and other objects travelling at enormous speeds is one of the many remarkable achievements that are now carried out by means of the camera, here described by J. F. Stirling, M.Sc., A.I.C.

In its strictest sense the term "ballistic" applied to photography refers to the portrayal of small projectiles, such as bullets, in motion. The expression, however, now tends to be used in a wider sense to denote the photography of any object which is in extremely rapid motion.

It is obvious that for ultra-fast photography of this nature even the quickest of mechanical shutters is useless, its exposure time being far too lengthy to arrest the motion of these fast-travelling bodies. The problem, however, has been successfully attacked along two main lines. In the first place, if the object to be photographed is sufficiently luminous it may be made to record itself upon a strip of sensitive film or paper attached to the edge of a drum revolving at a high speed. The passage of an explosion wave through a quartz window in a metal tube has been successfully recorded by the late Prof. H. B. Dixon and others by this comparatively simple method.

In the more spectacular applications of ballistic photography, advantage has been taken of the fact that the spark discharge from a Leyden jar or other large-capacity electric condenser is of an exceedingly short duration, lasting for less than one millionth of a second, and it is by means of such an exceedingly short-lived illumination that the photographic exposure is made. Such methods are frequently classed under the heading of Spark Photography (*q.v.*),



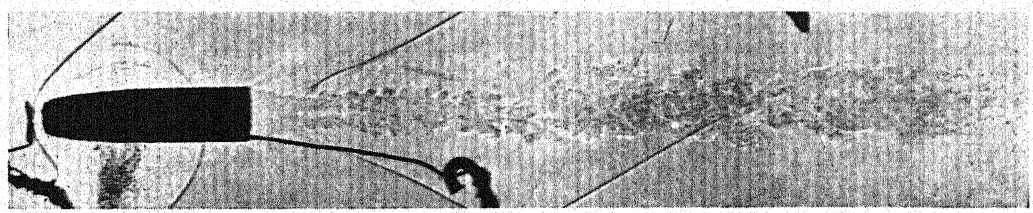
FASTER THAN SOUND. Designed by Professor Cranz and Mr. Schardin, this apparatus can photograph a rifle bullet as it passes the camera's nine lenses at the rate of 2,950 feet per second. A device on the rifle muzzle fires a series of sparks in succession, their release occurring just prior to the bullet passing the camera's field of vision. The nine sparks correspond to the nine lenses of the camera

but they are, in a wider sense, applications of ballistic photography.

Using methods of spark illumination, it has been found possible to photograph ripples upon the surface of liquids, the falling of drops into liquids, with the consequent development of splashes and many other interesting effects.

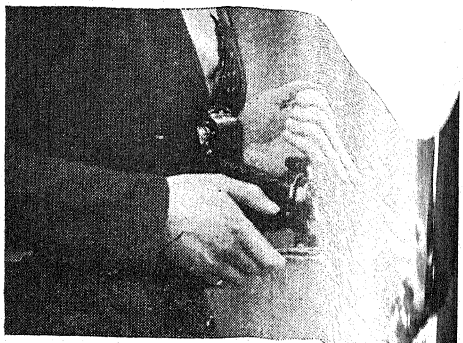
Bullet Silhouettes. Ballistic photography proper—the photography of bullets in motion—is chiefly the outcome of the work of Prof. Sir Charles V. Boys. A bullet, when it emerges from the barrel of the rifle, travels at a rate of about a thousand yards a second, which is faster than the velocity of sound. In order to arrest its motion it is necessary to reduce the duration of the illuminating spark to about one ten-millionth of a second. This requirement is effected by the employment of special discharge condensers, the bullet being spark-illuminated at a definite point in its path. The illumination throws a shadow of the bullet on to a photographic plate and thus records its motion. It should be noted that in this method a lens is not employed for the purpose, since it would absorb too much of the valuable illumination derived from the spark. The bullet, however, is clearly silhouetted, as are also the compression waves of air formed in front of it, as seen in the photograph at the bottom of this page.

A still more recent application has been made by Prof. Cranz and Mr. Schardin. These workers cause the bullet to be fired in front of and parallel to a series of nine electric condensers which are automatically discharged in rapid succession. The nine successive sparks illuminate the bullet at consecutive portions of its flight, the light

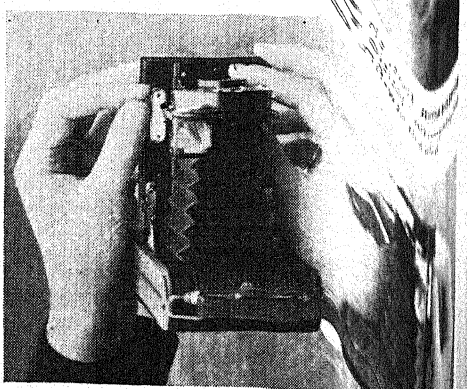


PROJECTILE'S FLIGHT. In this remarkable photograph by Sir Charles Boys of a moving rifle bullet the compression of air waves set up by the projectile are clearly seen. The illumination is provided by special electric condensers

Photo, Newtonian Illustrated Press Service



NOTES FOR NOVICES. Above, th holding a folding camera when " positio be taken in the view-fin



Focussing the folding camera (above), one side of the camera, shows the posit front of the camera to be set to obtain c at varying distances



How to hold a roll-film folding came This photograph shows the correct posit hands when making an exposur

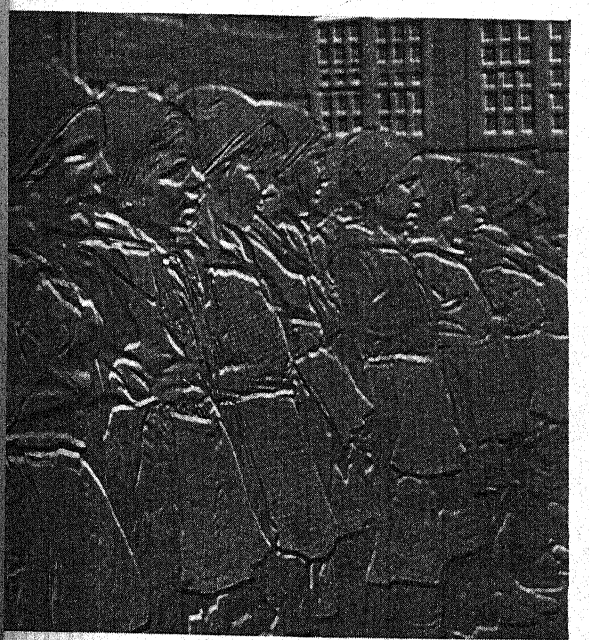
are available in standard grades with various surfaces, and there is a wide range of chloro-bromide papers for use in making contact prints and enlargements.

BARYTA PAPER. Paper coated with a mixture chiefly of barium sulphate ($BaSO_4$), sometimes spoken of as *blanc fixe*, and gelatine. It is largely used in the manufacture of photographic printing papers, the barium substratum giving a pure white surface and protecting the sensitive coating from any impurities in the paper itself, as well as preventing the emulsion from sinking into the paper, which would result in dull prints.

The coating of the paper with baryta is a highly specialized branch of the photographic industry, the mixture being applied to the paper and distributed over it in a uniform layer by brushes which move across the surface of the travelling bands of paper in different directions. *See* Bromide Papers.

BAS-RELIEF PHOTOGRAPHY. Bas-relief photography consists of producing results having images in actual physical relief, or with an optical illusion of it.

The first variety depends mainly on the characteristics of bichromated colloids or gelatine. A process block is in effect a bas-relief, consisting as it does of a metal relief

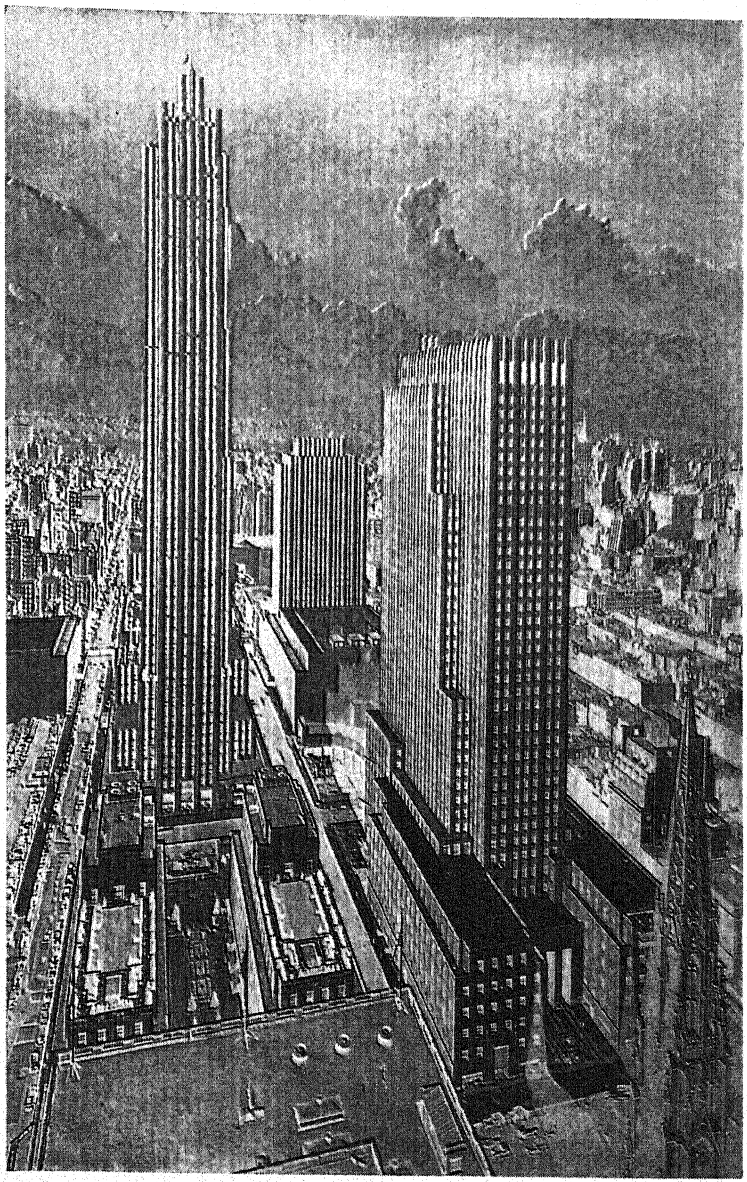


AT IT SEEMS. Bearing a striking resemblance to an actual bas- hotograph was produced by means of a combination of a positive cy and a negative. The method involved is described in page 153

Photo, David Charles

produced by etching through a stencil resist itself made by printing in light-sensitive bichromated colloid; but this method is capable of only two planes, a raised one upon the etched background. Bichromated gelatine (*see* Carbon Printing) produces a graduated relief, and some special varieties produce more relief than others, especially if developed upon a sheet of glass. The relief is greatest when still wet, and plaster casts can be made from such relief prints. Metal reliefs in their turn can be made from the casts by electroplating or simple casting methods.

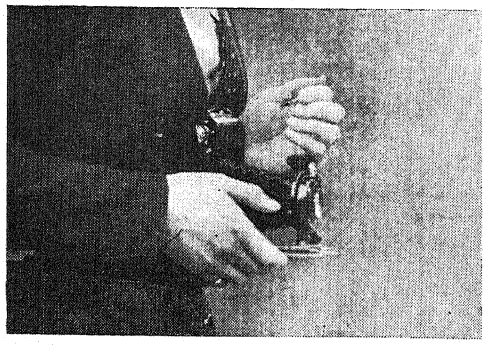
The second group of methods depends upon hand-moulding. A print on thick paper, or transferred on to thin metal (*see* Carbon Printing, Transfer Papers), is impressed with tools from the back, being laid face downwards upon a pad. Mass-production methods of producing bas-relief photographs have been in vogue, consisting of a relief die with a corresponding matrix, the strips of photographs being passed between them successively under pressure.



LIKE THE SCULPTOR'S ART. This pseudo bas-relief of the Rockefeller Centre, New York, conveys a most pronounced impression of chiselling and projection. The illusion is due to the texture of the photograph resulting from the unusual effect of light and shade on the various objects

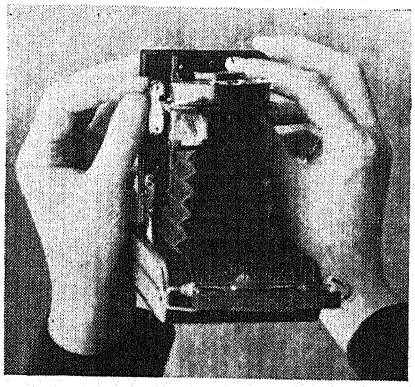
Photo, Irving Browning

Pseudo bas-reliefs, which are flat prints giving considerable and often very effective illusions of relief, are produced by two methods. One of these depends upon the producer's individual skill in preparing the subject and special arrangement of lighting. The second, more widely employed method consists of making a positive transparency from the original negative. When dry the positive is placed in contact with the negative but slightly out of register as regards the detail. When this combination is placed in a projection printer (*i.e.* enlarger) the result is often a peculiar effect of light and shade, very similar to the appearance of a plaster cast.—*DAVID CHARLES, F.R.P.S.*

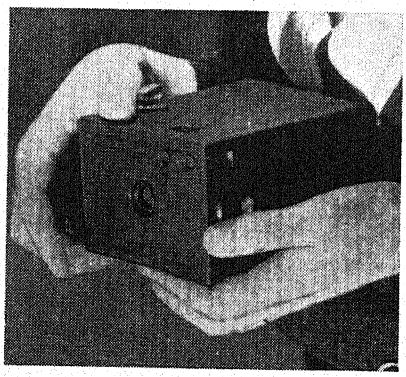


NOTES FOR NOVICES. Above, the correct method of holding a folding camera when "positioning" the object to be taken in the view-finder





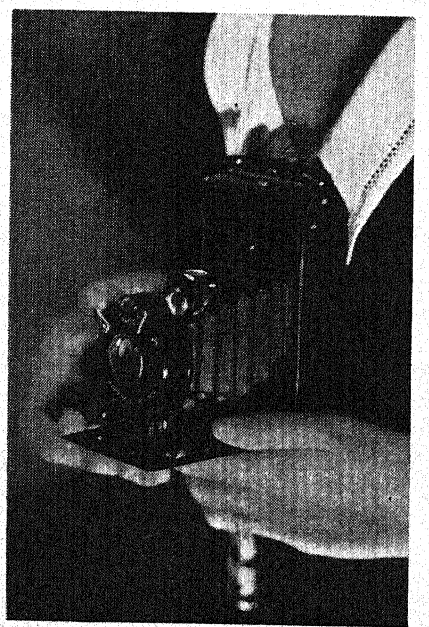
Focussing the folding camera (above). A scale, on one side of the camera, shows the position for the front of the camera to be set to obtain correct focus at varying distances



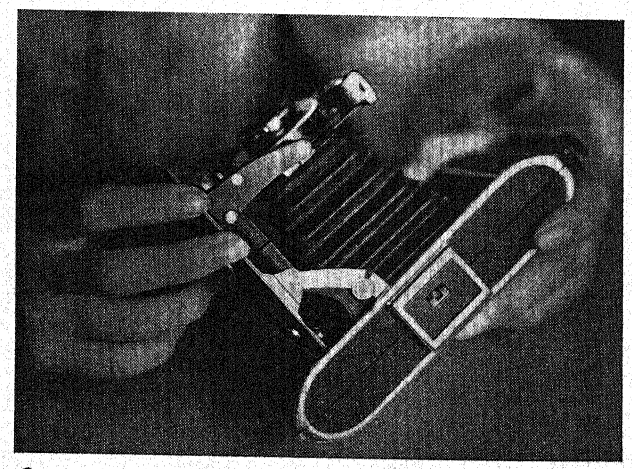
Using a "direct vision" finder at eye-level (above). This method, if the camera has the necessary attachment, is much to be preferred to that shown on the left at top

Photos, courtesy of "The Amateur Photographer"

Holding the "box" (left). The correct way to hold a box camera when pressing the shutter release



How to hold a roll-film folding camera (above). This photograph shows the correct position for the hands when making an exposure



Opening the roll-film camera (above). The base must be pulled down to its full extent, avoiding any such gaping in the side-struts as is shown here; otherwise, focussing will be imperfect

BEGINNERS: HINTS AND TIPS

Every year thousands of newcomers are added to the ranks of the large army of amateur photographers. The aim of this section is to help those of them who know little or nothing about photography and to encourage them to become still more interested in a useful and fascinating hobby

See also Box Cameras ; Camera ; Composition ; Developing ; Enlarging ; Faults

Most amateur photographers commence photography for one of two reasons—either some friend or relative gives them a modest camera and they become intrigued with the results, or else some special occasion seems to demand that they make a picture record of it. They rush to the nearest dealer or chemist, purchase the first instrument offered, have it loaded with a film and fire off a number of exposures without further thought.

Like all hobbies that are worth while, photography, although one of the easiest for getting results from the very beginning, needs keenness and the ability to stand up to occasional disappointments with equanimity ; however heart-breaking they may seem, the cause of failures can always be fathomed and a cure effected.

Here, then, is the first lesson for the novice to learn. The apparatus, if it is at all reliable, and most modern cameras are, will take good photographs if the man behind it will operate it as it ought to be operated.

The First Camera

The elementary details of the camera and how it works should be studied, so that the amateur can readily see what each component is intended to do, and also, what is perhaps more important, its limitations.

Thus, if he has a box camera with a single-speed shutter, he must understand that he cannot hope to get objects moving at great speeds ; or, again, if his view-finder is a considerable distance away from his lens, his close-up views in that accessory will not be accurate, and allowance must be made. Only a couple of minor details, you say, but they give the idea that is intended. Every part of the camera has some specific use, and it should not be abused, either verbally or practically.

If the novice has been given or has acquired a box type of camera, he may soon want something more advanced, though it should not be forgotten that many first-class photographs have been taken with box type cameras, and some amateurs never do better work with more expensive cameras.

When buying a more expensive camera the temptation for the novice is to buy an instrument with a large number of gadgets attached. They all look so important, and, indeed, they are, but it must be remembered that they also add to the complications of operating the instrument.

Getting a Better Camera

Nowadays, when it is so easy to exchange one camera for another, it is a wise idea to proceed by easy stages ; to choose, say, a folding pocket roll-film camera with three-speed shutter and about an *f*6.3 lens to supplant the box instrument.

Having become quite familiar with this, and in the happy position of being certain to produce the negative aimed at, then is the time to exchange it for something a little more advanced, either in the same type of instrument with a larger aperture lens and a Compur shutter, or perhaps a miniature. In every case, however, the instrument must be thoroughly understood first.

" Processing " Advice

Then comes the question of what to do about " processing," which is the term applied to the making of negatives and prints. Is it better to do your own, or to let the dealer or chemist do it all ?

This is a matter which must be decided by the amateur himself.

Novices are often advised to get their first exposures developed and printed by a D. and P. firm (" D. and P." stands for " Developing and Printing "). If a reliable firm is chosen this is good advice, because such a procedure gives them an idea of what the finished negatives should look like, and also locates any faults in their working.

However, the keen amateur will never be really satisfied until he has attempted his own processing, and since the manufacturers have made it so easy nowadays, he need have no qualms about making the attempt.

Of course, if he is going in quickly for a miniature camera the beginner will certainly be wise to get his film developed by some miniature specialist, because these films are rather difficult for a novice to handle, especially if he has not already become familiar with developing technique with larger-size material.

In the purchase of his camera the amateur would do well to remember that he almost certainly will need an enlarger in the near future. If his expenditure is likely to be limited, he would be wise to content himself with a little more modest instrument, with, however, the best lens he can get at the price, even if it means sacrificing one or two other refinements, in order to have enough to spend on a decent enlarger.

The beginner would do well to study the pictures in this publication and other journals, and in exhibitions, and then go out and try to find subjects like them, even if they are almost identical, until, having acquired the art of " seeing " a picture, he can start on an original line.

The most important advice for the novice is, without doubt, to seize every opportunity of studying his hobby from various sources ; by reading photographic books and magazines, and by joining a photographic society, where the practical help of other members will prove of the greatest value.

Making a Start

Nowadays, the taking of snapshots with the regular camera obtained from any dealer is a very easy matter indeed, and while there is really nothing to confuse the beginner, there are still several simple points to consider if the best results are wanted.

We will assume, therefore, that you have obtained an ordinary roll-film camera, which is probably the most popular form for snapshots, and is in use everywhere.

At first it may be well just to open it and not take a photograph at all, but merely to point it at the subject.

If we were going out with a gun to shoot rabbits, we should quite understand two things : first, that the gun must be pointed at the rabbit, and second, that even if we are following the rabbit with the gun, we must keep the gun steady just at the moment of firing. Now, in order to secure a good photograph we must point the camera at the object, and we must, when making the exposure, take great care not to shake the camera.

Do not let us worry ourselves at all at the moment about the time of exposure, or the strength of the light, or the stop in the lens, but simply think of these things, pointing the camera at the object and making the exposure without shaking the camera.

When using the gun we look along the " sights " in order to get a good aim. The camera is provided with " sights," though in the case of the camera we call them " finders." These finders serve no other purpose than to show you just what the camera is pointing at.

How to Hold the Camera

The little image on the top of the finder is really just what your photograph will be. The photograph will be about two inches by three inches, but the image on the finder is the same picture in miniature. Now hold the camera in both hands, holding it firmly, but not gripping it too tightly. Gripping too tightly causes a vibration or trembling of the muscles after a few moments, and this trembling is communicated to the camera.

Of course, you are holding it level. Do not point the lens up or down, and do not let the camera lean over to one side.

It is important that you should acquire the habit of bringing the camera into action, so to speak, in exactly the proper position. This is important in such work as street scenes or figure studies, because you always want to photograph the subject immediately you see it, before it has had time to change.

Now we will walk on for a few yards, and then you may again bring the camera into action, and if you do this a few times you will find it becomes quite a simple matter.

When you have drilled in this way a little, you should begin to look into the " finder " just at the moment when you have the camera levelled in front of you. Hold the camera at the waist-level, pressing it against the body, and by leaning forward just a

trifle you can bend your head and get your eye over the finder.

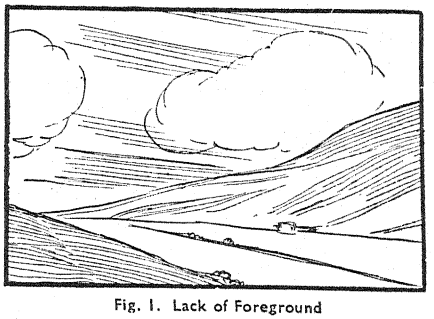


Fig. 1. Lack of Foreground

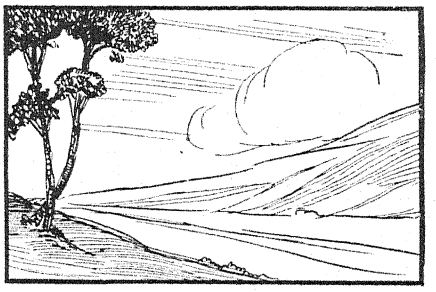


Fig. 2. Foreground Interest

With some types of finder it is essential that the eye should be exactly above, as the miniature image seen in the glass varies with the position of the eye. In any case, the image is seen more distinctly if the eye is exactly above it.

The advantage of bringing the camera into working position automatically will now become apparent, for you must begin to think about another point. Here is a roadside cottage which looks picturesque. Hold the camera in front of you and rapidly glance at the image in the finder. The cottage in this little finder image is, however, a mere speck. The road in front of you seems to occupy most of the picture, and there is a great expanse of sky. You are too far from the cottage. Walk on perhaps a dozen yards, and then again look into the finder. That is better, is it not ? Though probably you may get yet a little nearer still.

Quickness in "Snapping"

Now this brings us to the second point which is bound to occur very soon. Your best snapshots are likely to be those when you have approached your subject quite unconcernedly, rapidly sighted the image in the finder and exposed at once before any figures in your subject have had time to notice what you were about.

If, however, you stop every few feet and hold up the camera and look into the finder, the figures will become self-conscious.

What you want to try for, then, is to estimate by the actual size of the object you are going to photograph about how far away you must be to get an image of suitable size on your finder. This will prove very easy after a little practice.

While you are doing this there is a third point you may also practice—the releasing of the instantaneous shutter. Probably nine beginners out of ten shake the camera badly. One reason for this is that they press on the trigger or button without taking any special precaution to balance that pressure by pressure in the opposite direction.

As a rule, cameras have the trigger of the shutter so placed that it can be released by the thumb, and if the fingers of the right hand are placed underneath the camera, it is only necessary to pinch the thumb and fingers together, the downward pressure on the trigger being balanced by an upward pressure of the fingers supporting the camera. This "pinching" must be done gently, yet at exactly the right moment.

You have now learnt the three primary essentials for taking photographs : (*a*) lifting the camera to the waist-level, keeping it in an exactly level position ; (*b*) sighting your object by looking into the finder ; (*c*) pressing the trigger to release the shutter without vibrating the camera.

Many a landscape subject which looks attractive enough to the eye to prompt an exposure fails to hold the same interest when seen again in the print.

This can often be attributed to the failure of the photographer to include something that will provide and maintain the interest *inside* the picture.

Fig. 1 is typical of many landscapes by beginners. When it is compared with Fig. 2 the powerful influence created by the trees is appreciated. It will be argued by many that if the trees were not there in just that position to suit the rest of the landscape, how can they be included in the negative ?

It must always be appreciated that nature does not group itself specially for pictorial work. If we examine Fig. 2 again, we can see how the inclusion of the trees from another negative, which

can easily be over-printed into the landscape, provides the main point of interest and fully justifies such creative composition. This is a constructional device that is perhaps most commonly used for grouping such subject matter as demands stability.

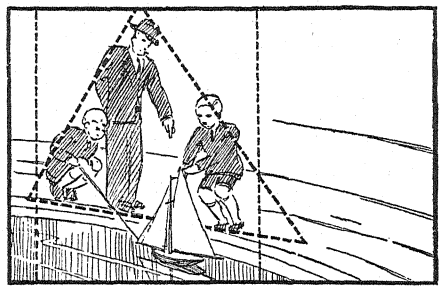


Fig. 3. Pyramid Construction

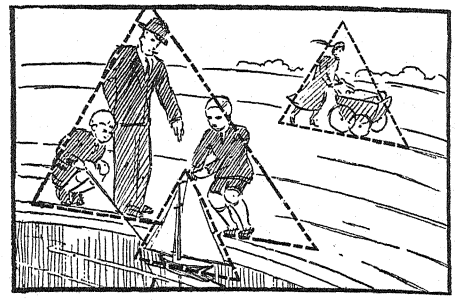


Fig. 4. Triangles Triplicated

Although the subject matter of Fig. 3 is the human figure, the triangle or pyramid construction can be applied to many other things that can be photographed. The group here shows only one triangle traced round it, but we may add (as in Fig. 4) shapes or groups that suggest two or even more triangles of different sizes and proportions placed in various positions throughout the picture space.

The contour of the group must not conform too closely to a triangle, otherwise the arrangement will look too mechanical and lack that dash of spontaneity that contributes so much towards the appeal of a good picture.

The fundamental idea of the pyramid construction is that the base gives a solid foundation for the group, but it may also be used with the apex at the bottom.

When this is done, however, there is a great danger of the arrangement looking precariously balanced at the bottom point, particularly if this just touches any line going across the picture. There is no rule that the pyramid must stand on its base, but when it is desired to invert its position, then the subject matter must be arranged so that extra support is given on one or both sides to give it stability.

Although one of the simplest of the fundamental structures for pictures, the diagonal principle can be one of the most effective.

As it can be used equally well with the simple theme as with the more involved compositions, the beginner is advised to experiment with this principle. Figs. 5 and 6 illustrate this point quite clearly, and show how an otherwise unattractive picture can, by simply changing the viewpoint taken up by the camera to a few yards to the left, turn the same subject matter into an extremely interesting arrangement.

But, as with all other fundamentals in composition, it must not be slavishly copied with mathematical accuracy. It should never divide the rectangle into two equal parts, and the diagonal line, whether it is the contour of figures or buildings, of still life or merely cast shadows, should never be perfectly straight. Neither should it go right to the opposite corners, but be " held " from going out of the picture by suitable items as is suggested in this instance, by the boy and the kite.

When the diagonal line is well defined, such as that of the kite string here, some variations are needed to relieve the monotony. The clouds have been included here for this purpose, and if they are covered up temporarily by the fingers their value in

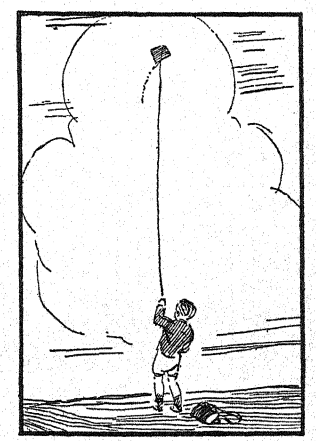


Fig. 5. Dull without Diagonal

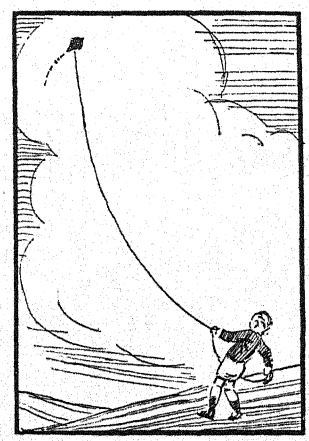


Fig. 6. Diagonal's Improvement

this respect will be appreciated.

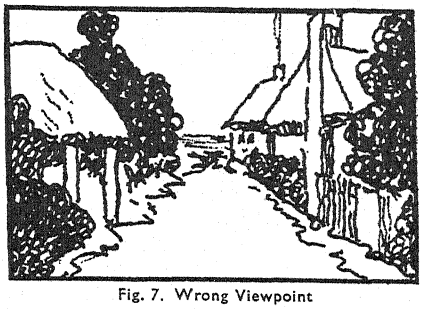


Fig. 7. Wrong Viewpoint

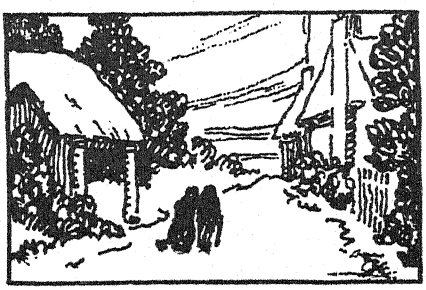


Fig. 8. Right Viewpoint

It is subject to the predominating rule of such "structure" composition, that it should not draw attention to itself, but merely influence and strengthen the general scheme.

It is a good thing to remember in pictorial photography that in almost every picture the best viewpoint only is to be found by searching. Very seldom is the first view seen the best. In Figs. 7 and 8 the viewpoint has been altered by not only moving to one side but also lowering the camera.

The main criticism against Fig. 7 is that by choosing a point in the centre of the path the eye is led immediately straight towards the end of the lane and past the cottages, thereby missing the real *motif* of the picture, the lane and cottages themselves.

By moving to one side and placing the end of the lane on one of the " thirds " we get variety into the picture, and by lowering the camera we cut out some of the uninteresting ground. At the same time, by raising the lens panel, or by slightly tilting the camera, we can add to the height and dignity of the scene. This is shown in Fig. 8, in which human figures have also been introduced to provide a definite point of emphasis.

This point applies to almost every picture where there is regularity on either side, interiors of churches and cloisters, as well as avenues and streets.

In the sketches shown it is immaterial whether the viewpoint chosen was either to the left or right, as both sides of the lane are of equal interest. But in a picture, say, of an interior of a church looking down the nave, the lighting would probably decide the viewpoint, while in an interior of cloisters the viewpoint would be nearer the less interesting side.

When taking snapshots of buildings or anything that has straight, vertical lines, it is a mistake to tilt the camera in order to include the whole of the subject because one is too near to it to get it " all in " when the camera is held in the normal position. Although the desired object may be attained, the effect is unnatural, and in Fig. 9 the result of tilting the camera is shown. The vertical lines converge at the top and buildings appear to be falling down. This distortion is not a fault of the lens, but is due to the fact that the back of the camera is not parallel with the subject, *i.e.* vertical. In the same way if the camera is pointed downwards, similar distortion is bound to occur, and another type of subject has been chosen for Fig. 10. The head of the baby being nearest the lens is caused to look much too large for the rest of the body. This explains why animals look distorted when photographed from above. The remedy is—hold the camera lower, level with the subject, and keep vertical. It must not be thought that the camera can never be tilted, as with many subjects, such as landscapes, etc., it is impossible to tell what position the camera was in, but the beginner is advised to keep the camera level as much as possible, particularly when

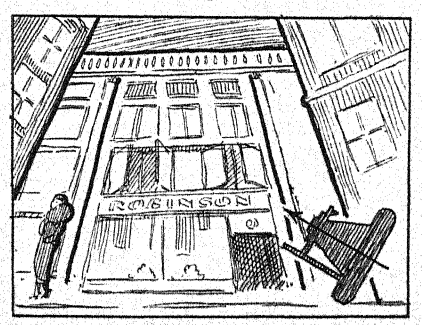


Fig. 9. Effect of Tilting

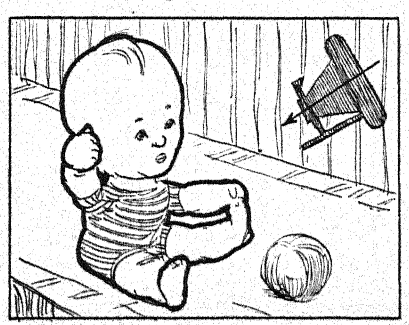


Fig. 10. Tilting Causes Distortion

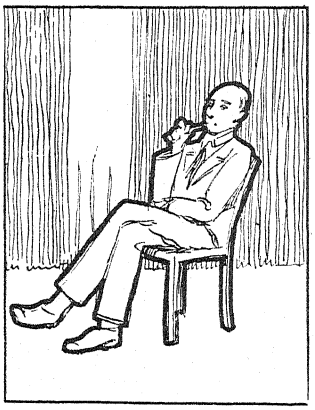


Fig. 11. Correct Full-length Portrait

straight, vertical lines appear, or when "close-ups" are taken.

There is always a big temptation to make the figure fill the view-finder as much as possible in order that it shall be as large as possible in the print. This is quite in order, provided that the figure is placed sideways to the camera as in Fig. 11, and not in a position as that shown in Fig. 12. Because the feet are nearest the lens they photograph out of proportion to the hands, which are a little farther back, and, in turn, the hands are larger in comparison than the face, which, after all, is, or should be, the main point of interest for studies of this character. If you must fill the picture with the figure, place the camera so that the sitter is almost broadside-on, then everything will be in proportion. If a front three-quarter view is desired, similar to the first pose, then it is better to keep well away from the sitter, say from six to ten feet, when the distortion will not be so evident. If the figure is lying full-length, or reclining on the ground, never snap it from this three-quarter front view, as the feet will always look too large.



Fig. 12. "Foot Distortion"

Disappointment in photographs of views taken from great heights can generally be attributed to one or two facts. The impression of height is either not conveyed in the print, or else the view has been dwarfed and is not so clear as it was to the eye. The last two failings can, in the main, be remedied by using a long-focus lens and a film with a suitable filter to penetrate what haze is present. This will also give a little more contrast in the usually flat tones of the landscape.

Pictorially, however, much can be done, even when using the usual lens and film, by including some foreground and sometimes a figure. If the scene is similar to Figs. 13 and 14, a horizontal or "landscape" picture is better, because in the upright view the subject is divided horizontally too many times, with a consequent loss of interest. Choosing the horizontal view, and stepping back to include a little foreground, makes a more satisfying picture, and immediately gives the impression of great height.

Maintaining Interest in the Picture

The interest in a picture depends largely on the "lines" of the subject matter. If the interest is to be held, the essential of all pictorial photographs, the lines should guide the eye into the picture gradually up to the main point of interest. In Fig. 15 the bridge, which dominates the picture, has a wedge shape and takes the eye immediately to the left and right out of the picture.



Fig. 13. Upright Wrongly Used

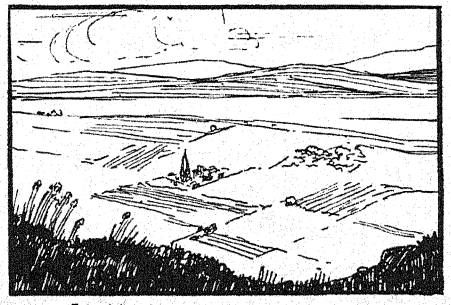


Fig. 14. Horizontal Oblong for Views

Even the clouds, which also possess "lines," point in the same direction, and do not help in maintaining interest. Clearly a stopping-point is indicated which will return the eye into the picture and give it some pictorial interest. This is where a figure can be

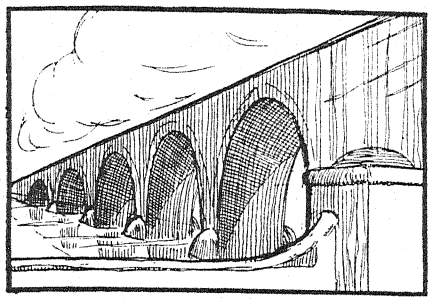


Fig. 15. Subject in Shadow

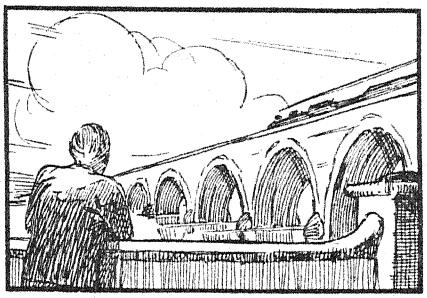


Fig. 16. Subject in Sunlight

helpful. Make sure that he or she is looking towards or into the picture, and not in a too prominent position; otherwise the interest will be divided between the figure and bridge. Notice, in Fig. 16, how the clouds, which point towards the right, also help to counteract or "oppose" the lines of the bridge.

The direction of the sun can do much towards the modelling of the subject. In Fig. 15 the sun is over the right shoulder, throwing a whole bridge into shadow and making a light foreground. In Fig. 16 the sun is to the left-front, giving a more pleasing effect and a dark foreground.

The Vanishing Point in Landscape

There is a tendency with most beginners to "centralize" every subject and to get the distant vanishing point in the middle of the view-finder (Fig. 17). This is best understood by referring to where the heavy dotted lines all tend towards the centre, usually called the "vanishing point." It is quite evident that wherever this has occurred the photographer thought that it was the only position in order to show as much as possible of either side. This is perfectly true, but such pictures are weak *pictorially*, although they are strong *geometrically*. Very seldom is a symmetrical picture interesting.

Compare this with Fig. 18, where the vanishing point is to the side and a little lower. There is now variety in every shape and area, and immediately it becomes more pleasing to the eye. Now look around at good pictures, paintings and drawings, as well as photographs, and see how often this occurs. Sometimes the vanishing point is on the right, sometimes higher, and sometimes even lower still. There are various factors of pictorial composition which help to decide where this vanishing point shall be in relation to the four sides, but for the time being the beginner is advised to keep it either to the right or left of the centre, and a little lower or higher than the midway horizontal line. In Fig. 18 a human figure has also been added to increase the interest and lead towards the vanishing point.

If in doubt as to which side to choose, take up the position which shows more of the interesting side of the road, such as that seen in sketch, where the right-hand side with the cottage is more attractive than the left, with its plain wall and tree.

Most beginners are loath to trim anything off their prints, particularly with contact prints. It may be due to the fact that the print will look skimpy after liberal trimming, and so reduce it down to a picture that could have been taken by a miniature camera. Others will argue that the lens was, say, an anastigmat, and therefore everything that the lens included in the picture was perfectly correct for perspective and quite free from distortion. This is partly true, but, as far as the print is concerned, it does not reckon with the truly aesthetic point of view.

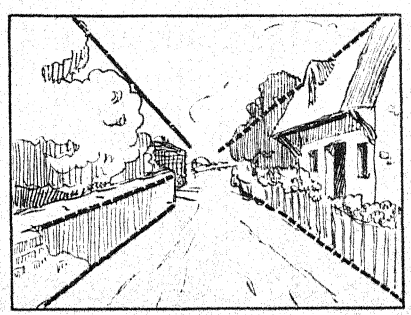


Fig. 17. Wrong Vanishing Point

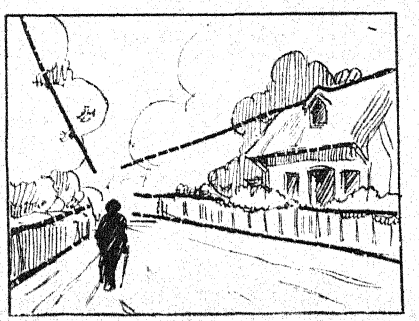


Fig. 18. Vanishing Point at Side

Most beginners' cameras are fitted with lenses whose focal length is approximately the same as the diagonal of the negative. This gives a " field of view " that is much wider than can be seen by the eye in any one position, and consequently looks " unnatural." This is most noticeable when we have subjects that lead away into the distance straight in front of the lens. This is called foreshortening. It must not be thought that this extreme foreshortening is a defect in any particular lens, as all lenses will show this same characteristic.

Most photographers are aware that a lens in a rising front will eliminate the intrusive foreground, like that shown in Fig. 19, but perhaps they do not realize that extreme foreshortening is not concerned with the ground only, but applies to all planes, whether they are walls or ceilings, or whether the camera is pointing up a lift shaft or down the stairs. This apparent fault of foreshortening is not always, of course, a serious fault in the composition of a photograph ; indeed, it may very well be a virtue in certain circumstances when it adds to the effect which it is desired to produce by concentrating emphasis on the central factor of the picture. But as we are concerned only with the pictorial side of the picture, it is better to take off some of the superfluous surrounding " field " when we have subjects like that illustrated. Especially as in this case nothing of pictorial interest is sacrificed. Left or right, above or below, the trimmed portion only provides a repetition of the pattern already contained in the central portion. The dotted lines show the suggested trim. This helps us to concentrate the attention on the real subject matter without having unnaturally large foreground items.

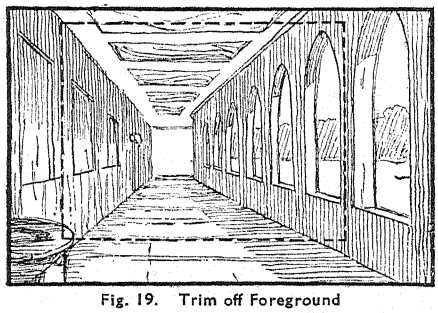


Fig. 19. Trim off Foreground

The next point is concerned with light tones on the edges of prints, mainly those that are mounted on light mounts, particularly prints with dark heavy tones. If we had a picture like that shown roughly in the sketch, Fig. 20, at the bottom of this page, and put it on a white or cream-tinted mount it would look as though it had been trimmed with scissors round the contour of the trees, and not with a straight edge, as is usually done. The borders have been purposely left out in order to make this point clear and to show the effect.

We may, of course, mount it on a dark mount, which would then contrast the white patches and so reveal the straight edge. But this kind of treatment is to be deplored. There are two other remedies which are far better. The first is trimming out the white patches wherever they occur, or, should that spoil the composition, we have the alternative of toning down the lighter patches by hand-work until they are suitably darker.

In Fig. 21 of the barrels, where the tops and corners have been left light, the same effect occurs. To trim them all away would immediately cramp the remainder, and in such a case we should have to resort to retouching, preferably on the print. This can be done in a variety of ways, but the beginner is advised to use a pencil first until sufficient experience is gained in matching tones, and then, later on, use a fine brush and water-colour tints. For further information on this delicate art, *see* under the headings Retouching (for negatives) and Working Up and After Treatment.

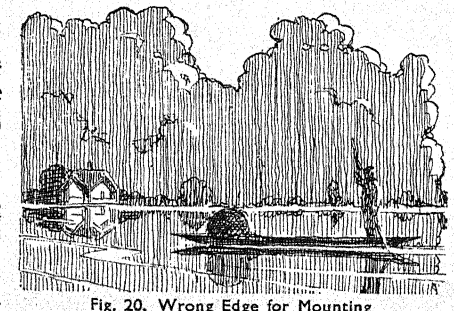


Fig. 20. Wrong Edge for Mounting

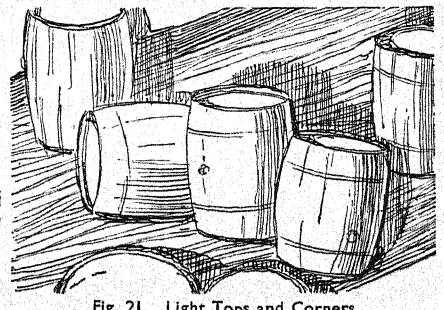


Fig. 21. Light Tops and Corners

Hints on Films and Film Sizes

There is, practically speaking, only one size and one " fitting " of film-spool that will fit any individual camera, but some cameras are made so as to take twice as many pictures on a single spool as it would normally give. This is achieved by means of a thin metal " mask " fitted inside the camera back. This has a window half the size of the normal opening, so that the resulting negatives, and, of course, the contact prints from them, will be half the size of those which the camera takes in the usual way. This device is intended mainly for those who intend to go in for enlarging, since the results are rather on the small side.



Fig. 23. 3×4 cm. size

Even in the most popular size of spool, commonly known as size 20 or sometimes 120, there is more than one kind of *fitting*. There is first the ordinary thick spool with wood or metal stem, and there is also the thin all-metal spool. This kind is made to fit cameras known as " six-twenty." It has a much smaller end-slot, and the cartons in which one buys the film are usually labelled " 6–20."



Fig. 24. 24 × 36 mm. (miniature) size

Some makes of film have a letter code in place of the prefix " 6– "; for instance, Z-20 or MB-2. Fortunately, it is not really necessary for the camera owner to trouble his mind very much about these particular distinctions, because each camera is supplied with an empty spool of the right description in position for winding exposed film on to, and in any case his dealer will know which fitting to supply when told the name of the camera or when shown an empty spool.



Fig. 25 2½ × 1⅝ ins. size



Fig. 22. 6.5×4 cm. size

What is far more important to a beginner who sets out to buy his first camera is to decide upon the size of picture which he would most like to make. There are several points here which do not always meet the inexperienced eye. One point often overlooked is that eight pictures the size of Fig. 22 (6·5 × 4 cm.) cost exactly as much for film as do sixteen pictures 3×4 cm., the size of Fig. 23. The very small sizes have the advantage of economy, and they appear easier to take, because most small cameras require less care in focussing. But prints of these small sizes, it will be agreed, are not so " easy to look at." The making of enlargements will cost more, whether one's money is paid out for making them, or is invested in the necessary apparatus for doing it at home. Thus it is seen that decision upon which camera to buy will determine the size and the *fitting* of spools for use in it.

Whatever make of film is preferred, there is a further selection to be made. In almost every make and size there are several varieties of " sensitivity." There is first the " standard " or normal speed of film, which is also the cheapest. This is well represented by the popular shilling spool in the size 20, which produces eight pictures 3¼ × 2¼ in. (Fig. 27.) The same price buys a No. 27 spool of standard-speed film, giving eight pictures the size of Fig. 22, with a "vest-pocket" camera, or 16 pictures with certain other cameras making pictures the size of Fig. 23. In both these sizes there is then the one-and-two-penny spool of the " fast-chrome " variety, as well as two kinds and speeds in " pan-

chromatic" sensitivity at the increased price of eighteenpence.

We would like to suggest very strongly that for the beginner in photography the extra twopence for the "fast-chrome" spool is a substantial investment. It not only gives good results in light which would be too dull for the slower film, but it has several other technical advantages. Of these the most important is the increased "latitude," by which is meant the ability of the film to withstand the ill-effects of errors in exposure.



Fig. 26. 2¼ × 2¼ ins. size

Even when an exposure meter or an exposure guide is used as a guide, this latitude is of value, for the exposure is always based on the necessity for giving time enough to allow the darkest part of the subject to register itself on the film. If the brightest parts of the subject are very brilliant in comparison with the shadows, they must therefore receive too much exposure, and the extra latitude possessed by the one-and-twopenny films is a great help in rendering this slight over-exposure harmless.

Better rendering of colours and of clouds, and less extra exposure when a yellow filter is used, are further advantages of the "fast-chrome" film. Both these qualities are possessed in even greater measure by the panchromatic films, but these are, perhaps, better appreciated when some experience has been attained. (*See also* Films, where a tabulated list is given of the many makes.)



Fig. 27. 3¼ × 2¼ ins. size

WHAT THE BEGINNER SHOULD AVOID

Don't touch the glass part of the lens with the finger or thumb. A greasy finger-mark on the front of the lens will cause blurred results. Clean the lens by breathing on the surface and wiping the glass *very gently* with a soft cloth such as that supplied by opticians for spectacles.

Don't wind on to the next film, if you are using a folding camera, while the camera is shut; the lens mount and bellows may scratch the film.

Don't pull out the bellows too quickly, otherwise the suction will pull out the film or else cause the bellows to "cave-in" and so cut off a part of the picture.

Don't load or unload roll-films in the camera in the direct sunshine. If you can't get indoors turn your back to the sun and open the camera in your own shadow. Otherwise the edges of the film will have black patches where the light has penetrated.

Don't use a slower speed than 1/25 second when exposing from the hand. Very few people can hold a camera perfectly still at 1/10 second or slower, particularly if it is a small camera.

Don't leave any fingers in front of the lens while you are making the exposure. It is surprising how they can block out the view.

Don't jerk the shutter trigger over when exposing. Try to "squeeze" it down by putting fingers on the other side of the camera to counteract the push.

Don't forget that a long cable release is better than the trigger release.

Don't waste a chance of steadying your camera, or yourself, when making a slow snapshot exposure. It pays, where possible, to lounge negligently against a lamp-post or other support, or to rest your elbows on a wall.

Don't forget, if your camera is standing on a wall or table, that the lens will see more of the support than does the finder. Push the camera right up to the far edge, and you are safe.

Don't point the camera directly towards the sun unless the lens is well shaded.

Don't forget that a low camera viewpoint is better than a high one when photographing babies or animals on the ground. It doesn't cause so much distortion.

Don't rub a dusty lens with a handkerchief. Far better to brush it with a clean camel-hair brush, and then, if any smears are seen, to breathe on it

and gently wipe the surface of the glass as suggested above.

Don't oil the shutter ; it does not require it.

Don't forget to wind the film on to the next number immediately after making an exposure.

Don't forget that a figure or object moving across the lens requires a much faster shutter speed than when it is moving towards or away from the camera.

Don't forget to set back the focussing to " infinity " before closing the camera.

Don't think that strong sunshine is the best light for portraiture. It causes the eyes to be screwed up and casts ugly hard shadows over the face.

Don't forget to adjust the graduated sky filter to suit the horizon if you decide to take a horizontal view instead of an upright one.

Don't forget to make sure that the view-finder, if of the kind that turns over for horizontal pictures, is properly in place.

Don't make a lens hood too long. It may cut off the corners of the negative.

Don't forget the " three S " mnemonic when about to make an exposure. Shutter speed, Scale and Stop ; and another " S " for Slide if you are using a plate camera.

Don't forget that it is better to over-expose than to under-expose. A negative that has had ten times the correct exposure will yield a far better print than a negative which has had only half the correct exposure.

Don't leave the camera lying about in the sun uncovered or exposed to the weather or inquisitive fingers. A camera case is a good investment.

Don't use a red lamp or " safelight " while developing panchromatic films. All such films are sensitive to red and will soon fog all over.

Don't forget that some so-called " safelights " are far from being safe. A spare, unexposed plate placed near the light for a minute or so and then developed out will soon prove it.

Don't forget to label the film " Panchromatic " if you are giving it to someone else to develop. Otherwise it might come back as " positives " instead of negatives.

Don't use a developer for more than one film. It soon gets exhausted and begins to stain, particularly pyro.

Don't put the thermometer back in the developer after taking the temperature of the hypo. Put it under the tap first.

Don't think that the dishes and measures are clean—give them a rinse and make sure, particularly if other people use them !

Don't keep taking the film out of the developer to see how it is " coming up." It causes uneven developing marks that can never be removed, and produces fogged negatives.

Don't let the hypo get anywhere near the developer. Always rinse the fingers in fresh water after contamination with the hypo.

Don't use the hypo for more than one fixing. Stale hypo can cause trouble, and it is false economy.

Don't coil up the film and leave it in the water and imagine it is going to be washed—even if you do leave the tap running. Coil it up the opposite way and pin the two ends together securely like a collar, and leave it to soak with periodic changes.

Don't forget that an imperfectly fixed film cannot be washed satisfactorily. Always leave it in the hypo until the creamy colour disappears and then give it another two or three minutes. Always keep the film on the move.

Don't try to dry the film by heat—it will only melt. Hang it up in a cool, dry place free from dust and carefully wipe it with a piece of chamois leather.

ACCESSORIES FOR THE BEGINNER

The only essential apparatus for the beginner is the absolute minimum. Not only does this greatly simplify the problem of what is necessary and what is not, but it effectively reduces initial expenditure to a small outlay.

Moreover, it is no uncommon thing to find a beginner commence working in one size or system only to change over after a while to a totally different one. By starting with the very minimum of apparatus there should be no great waste of accessories when such a change is thought desirable. Some of the apparatus can, indeed, be made to serve in the new capacity, whilst the convenient plan of gradually adding luxury and non-essential paraphernalia may then proceed without much wastage and overlapping.

What constitutes the very minimum of apparatus must always to some extent depend upon the nature and kind of camera employed. Before touching upon this, however, it may be better to consider the more general accessories.

Outdoor Devices. It may be said that a lens hood and a tripod are absolute necessities. " Against the light " effects are becoming more and more popular (thanks to their successful exploitation by our leading cinematographers), and it is both foolish and wasteful to attempt these without first shielding the effective part of the lens with a suitable hood. Hoods of the tubular variety are very apt to reflect the sunlight striking their lower (inner) surface into the camera, hence it is better to employ a " top-shade " or semi-tubular screen.

The most suitable tripod for excursion use is a light yet rigid affair—preferably of metal, and this may be purchased quite cheaply.

Other outdoor equipment should include an exposure meter. There is no more satisfactory system than that incorporated in the

various extinction meters on the market, but failing one of these a reliable meter of the Watkins or Wynne type may be recommended.

Later in his career the worker can, of course, acquire such things as light filters and film-pack adapters. Light filters, or colour screens, are very valuable aids to pictorialism, but their use is by no means indicated in all classes of photography. Film packs, too, despite their high price and the hard knocks they have received at the hands of certain experts, yield negatives that are practically flawless; no worker should be deterred from buying an adapter later on.

Indoor Equipment. Turning to indoor equipment, the serious worker will require apparatus for the development of exposed materials, as well as for printing and enlarging. In any case, a dark-room lamp is a necessity. Fortunately, most photographers nowadays have access to electric light, and it is possible to purchase special lamps for use in the dark-room. Perhaps it is best to select one of the available safelight lamps—with ruby, orange and panchromatic green safelights. These may be purchased in the photographic and electrical stores, and it is wise always to obtain lamps that will shed a comfortable glow.

Development. Highly efficient tanks may now be obtained for the convenient method of daylight development, and these are greatly to be preferred to any alternative where simplicity and comfort are desired factors. Tank development does not, however, make satisfactory provision for modification or control, and it is here that dish treatment proves its real worth.

The dishes employed should be of the deep, steep-sided variety, and in cases where the worker is dealing with plates they should be of a size somewhat larger than the materials being treated.

Finally, no list of indoor accessories would be complete without the humble thermometer; this costs so little, yet may be instrumental in saving such a lot.

BEGINNERS: HINTS AND TIPS FOR CINE USERS

HOW TO CHOOSE AND USE YOUR FIRST CINE CAMERA

The pros and cons of cine apparatus from the beginner's point of view are here discussed by an expert in simple and non-technical terms; and this introduction is followed by the thirteen cardinal points, explained in text and diagrammatically illustrated, of the correct use of that apparatus for the best results

See also Cinematography; Colour Photography, etc.

There are today so many different models obtainable that the amateur will have found it difficult to decide which cine camera adapts itself most satisfactorily to his particular requirements.

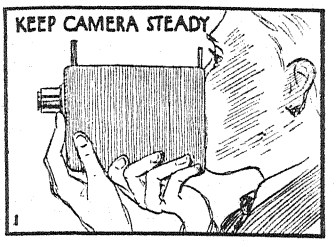
Before any choice is made the amateur must decide what kind of work and under what conditions he will require his camera to work. It will then be simple to pick out the ideal camera which is the most suited for the required conditions.

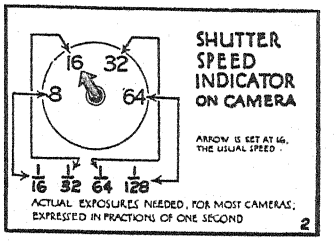
Fixed-Focus Models. If you want a camera that is as simple to work as an ordinary box camera and that will give perfect results in sunshine and on clear, bright days, then you should invest in what is known as a "fixed-focus" model, this being the most inexpensive kind and having the least number of mechanical adjustments to make before "shooting" the film.

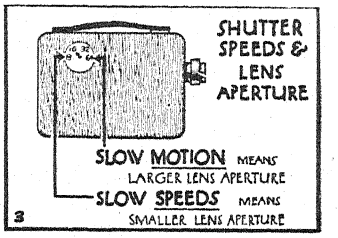
If, on the other hand, you want to make your films on dull, rainy days and at night, then the camera must be fitted with a large-aperture lens. It is with these models that a little extra care is necessary before the picture is made. The adjustments required are setting the aperture of the lens and also bringing it into focus by moving the lens mount farther out or bringing it closer to the film, all depending on the distance of the object from the camera.

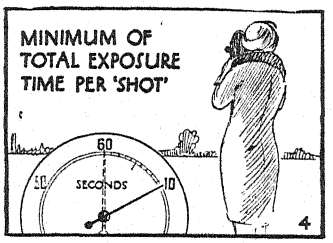
De luxe models are the last word in home movie cameras, and have incorporated in them many refinements that are found only on the professional camera. It is possible, with these models, to make both slow and fast motion pictures, to use a telephoto lens to bring distant objects within clear range of the camera, to change easily from one class of lens to another, and to perform other wonders of the professional screen.

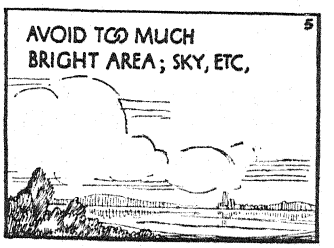
However, the more complicated the camera the more expensive becomes the initial outlay, and the more care and experience

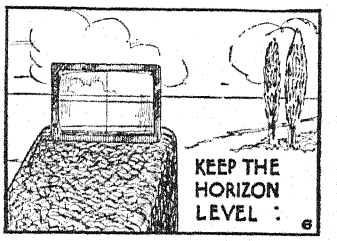


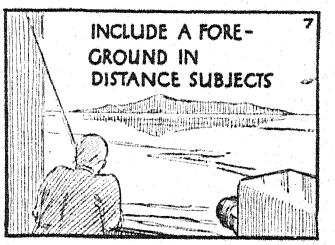












CINE POINTS FOR BEGINNERS
A few pictorial mnemonics for the amateur cinematographer are given above and in the following page, and are more fully commented on in the text. (1) How to hold camera. (2) Speed indicators. (3) Difference between slow motion and slow speeds. (4) Guide to exposure time. (5) Area of brightness advised. (6) Level horizon essential. (7) Necessity for foreground.

(*Continued in next page*)

required to operate it successfully. But if you feel that while purchasing a simple model you will want to tackle the more difficult situations in the near future, then it is advisable to purchase the more expensive model in the first place and begin to master its operations from the start.

Decide, therefore, what kind of lens equipment you want on your camera, and then examine the different makes, taking into consideration the items such as size, simplicity of loading, placing of controls, and so on.

Let us suppose you have obtained your first cine camera. Avoid temptation and *do not take any pictures with it at first.*

The advice, though apparently strange, is sound, for whereas a mistake with a snapshot camera means only the wastage of one small piece of roll film, a mistake with a cine camera may mean the loss of ten feet. Therefore, before you attempt to make your first " shot " learn your instrument.

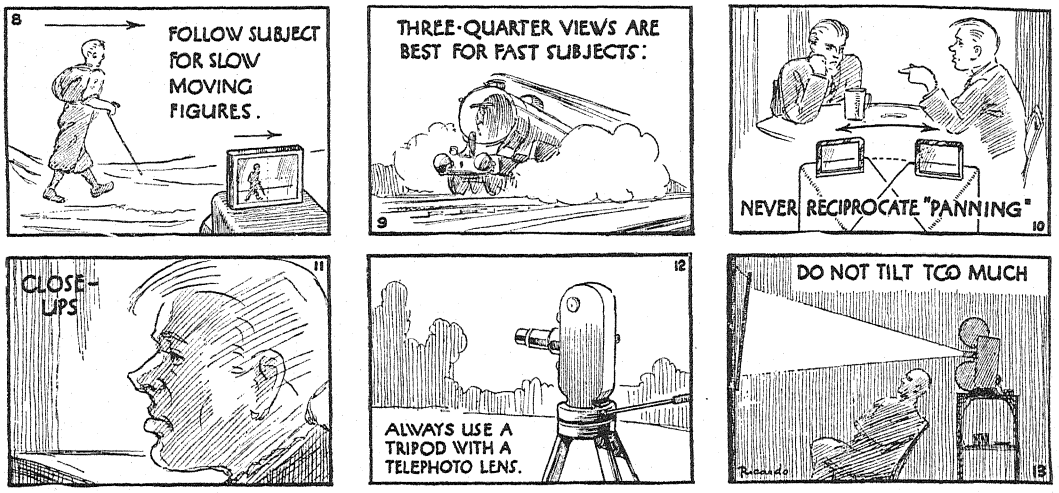
All hand cine cameras are intended to be held close to the eye in order to see the complete field of view, and though a tripod is strongly advised wherever possible, reasonably steady pictures can be obtained if the camera is held firmly against the face, as seen in Fig. 1.

Speed indicators (Fig. 2); these are the equivalent to shutter speeds of the " still " cameras, and must not be confused with footage indicators. But because of the mechanism of the cine shutter, all such speeds must be halved for actual exposure value, so that when exposing with, say, eight frames a second, each frame receives only 1/16 second exposure. With cameras that do not possess a speed indicator it can be taken that the shutter works the same as in the projector seen in Fig. 13, and this is sixteen a second, so that each exposure receives a 1/32 second exposure on the camera.

Fig. 3 shows the difference between slow *motion* and slow *speeds*. Bearing in mind the explanation of Fig. 2, the necessary alterations to the lens stops or apertures when changing over to different shutter speeds will be understood.

The tendency for most novices when handling a cine camera is to expose a length of film for too short a time. It is a good guide to aim at giving a minimum of ten seconds for each shot when using sixteen frames a second, although this can be cut down as faster speeds are being used (Fig. 4).

If the picture shows too much bright area, especially for any length of time, it is very glaring and tiring to the eyes when seen on the screen. If sky and water must be shown



CINE POINTS FOR BEGINNERS (*contd.*). (8) "Panning" for slow movements. (9) Three-quarter view for fast movements. (10) Never "pan" from side to side. (11) Close-up, with lens aperture one stop larger. (12) Tripod essential for telephoto lens. (13) Avoid tilt when projecting

a filter is advisable to hold back the "whiteness" or the transparency of the finished film (Fig. 5).

Remembering that a cine film cannot be trimmed like a "still" camera picture, care must be taken when exposing to see that the camera is held perfectly level when horizons and verticals are well in evidence (Fig. 6).

When exposing on distant views the big feature of animation is lost unless a slightly moving figure or foreground is included. This is not only a big help towards good composition but provides variety of tone values and gives a "lead in" to the picture (Fig. 7).

When following slow-moving subjects, called "panning," not only must the subject be followed steadily with the camera, but care should be taken that is is kept in the same relative position in the view-finder, vertically as well as horizontally (Fig. 8).

At normal shutter speeds never attempt to take fast-moving subjects going across the field of view, as only a dazzling blur will be the result when it is seen on the screen. Aim at a three-quarter view as in Fig. 9.

When exposing on two or more subjects that cannot all be included at once, never "pan" the different subjects in a reciprocating manner, from side to side, as this is very irritating to follow on the screen (Fig. 10).

In such subjects it is better to make separate shots, and this is an occasion where "close-ups" (Fig. 11) make a welcome change. But always remember to open up the lens aperture to one stop larger, as much of the light is cut out when a head looms up large before the lens.

When a long-focus or telephoto lens is used on the camera (Fig. 12), extra precaution must be taken to keep the camera steady, as all camera-shake will be enlarged when seen on the screen.

Projecting the film (Fig. 13). Do not tilt the projector too much, as it is very uncomfortable for the audience to have to look up for any length of time.

BELL AND HOWELL. Sub-standard cine cameras bearing this American company's name are amongst the best known and most widely used.

Known as "Filmo" cameras, they are made in several models. The smallest of these, known as the "Coronation 8," measures only $1\frac{3}{4} \times 3 \times 5$ in. and weighs but 24 ozs. It takes 8-mm. films and is built with a die-cast aluminium alloy housing. The shutter used is of the rotary disk type, and gives 1/35 sec. exposure at normal speed.

The lens is a colour-corrected anastigmat Anate ($12\frac{1}{2}$ mm. *f*3.5) designed so as to be quickly interchangeable with telephoto and extra speed lenses. Four operating speeds are available with the spring motor that is employed, these speeds giving 8, 16, 24 and 32 frames per second. On the side of the camera there is a hand-set footage dial which shows the amount of film that has been

exposed. The camera is set in motion by pressing a button on the front of the housing, and there is a built-in exposure calculator which provides a ready means of finding the correct lens setting. In spite of its small size, this cine camera can be loaded in daylight with 50 feet of film. Variations of the "Coronation 8" are the "Filmo Double 8" (illustrated in Fig. 1) and the "Filmo Straight 8." The former has a large aperture Taylor-Hobson Cooke 12½ mm. *f*2.5 lens, and takes the double-run 8 film. The latter is similar to the "Double 8," but takes the single width 8-mm. film.

The Filmo Model 75 for 16-mm. film is notable for its compactness and low weight—3½ lb. It is equipped with a twin spring motor, will take 100 feet of film at one loading, and runs at the standard speed of 16 frames per second. The standard lens used is an anastigmat *f*3.5, which is interchangeable with other types. A spyglass view-finder is built into the camera.

Model 121 is a box form-16-mm. camera, taking 50 feet of film at a loading. The standard lens for this model is a Taylor-Hobson Cooke *f*2.7, but lenses are instantly interchangeable. The film speeds are 16 and 24 frames per second, and provision is made for single frame exposures.

Filmo 70-E is a moderately priced all-purpose 16-mm. camera, operating at speeds of 8, 16, 24 and 64 frames per second. Lenses are quickly interchangeable, and the film capacity is 100 feet. Filmo 70-G is similar in construction but has a special mechanism for extreme slow-motion pictures operating at 128 exposures per second.

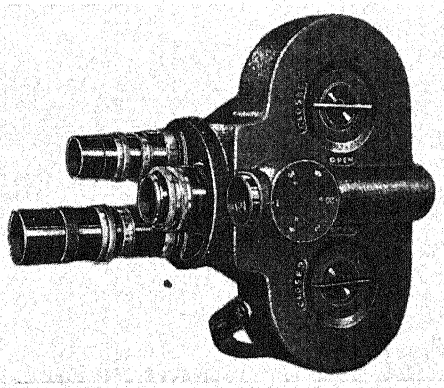


Fig. 2. Bell and Howell's "Filmo 70-DA" 16-mm. cine camera, with three lenses on a turret head

Filmo 70-D (Fig. 2) is a 16-mm. camera, operating at seven film speeds: 8, 12, 16, 24, 32, 48 and 64 frames per second. A rotating turret head accommodates three lenses, any one of which may be instantly swung into position. A spyglass view-finder is employed which, by means of a turning drum, is correctly masked for the field of view of any of the lenses employed. 100- or 50-feet daylight loading rolls can be used, and one winding of the motor operates 23 feet of film.

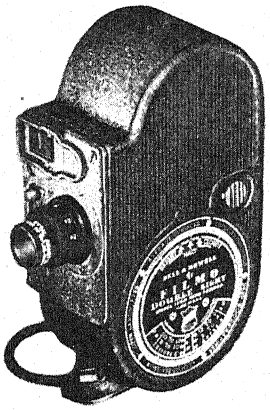


Fig. 1. Bell and Howell's "Filmo Double-8" cine camera, with a large aperture Taylor-Hobson Cooke 12½ mm. *f*2.5 lens

With the Filmo 70-D extra accessories may be employed, such as an electric motor drive, 200- or 400-feet external film magazines, a wipe-off unit and masks for double exposures.

The Bell and Howell Company also make a series of projectors. For 8-mm. film there is

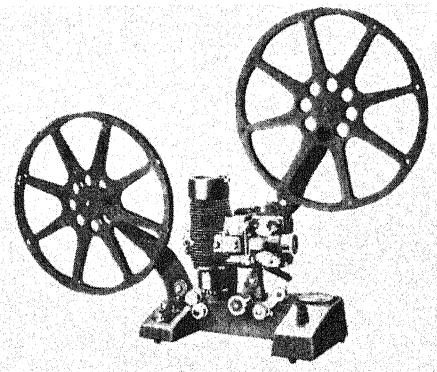


Fig. 3. The "Filmo 129" 16-mm. projector, by Bell and Howell. This model has 750-watt direct illumination

Filmo 8 projector provided with 400-watt direct illumination through a fast 1-inch *f*1.6 lens. Provision is made for still picture projection and for power rewinding, while the capacity is 200 feet of 8-mm. film.

The 16-mm. models comprise the Filmo S (750 and 500 watt); Filmo JJ (750 watt); Filmo 129 (750 watt) (Fig. 3); and the Filmo Auditorium Projector (1,000 watt). There is also a Filmosound 16-mm.

sound-on-film reproducer for educational, entertainment or commercial purposes. This is made in three models, varying in power of sound and illumination.

The Filmo JJ is an excellent projector for home use. It is fully gear-driven, even to the feed and take-up spindles, and by means of a variable resistance the lamp may be burned at less than 100 volts when full 750-watt illumination is not required. The Auditorium Projector, as its name implies, is particularly suitable for presentations before large audiences, its 1,600-feet film capacity permitting a one-hour programme.

Filmo S projectors meet the demand for less expensive 16-mm. machines, which will nevertheless show brilliant, steady and flickerless pictures, and will carry 400-feet reels of film.

BELLOWS. In folding cameras, the collapsible leather portion which joins the lens mount to the rear of the camera, forming a light-tight chamber, is spoken of as the bellows.

It is essential that the bellows should be treated with great care, for the slightest pin-hole in the leather will fog the film. A small tear can often be repaired with black sticking-plaster.

Sometimes it happens that a folding camera has been left in idleness for some considerable time, and the leather bellows have become hard and brittle. The best way to treat them is to extend the bellows gently and then rub lightly but thoroughly with a rag moistened in castor oil or sweet oil. Repeat the treatment daily until the leather is soft and pliant. Leather bellows may be kept in good condition by the occasional application of polish made by dissolving a piece of beeswax the size of a walnut in an ounce of turpentine and then adding a teaspoonful of linseed oil.

Great care should be taken to keep the bellows free from dust, which would otherwise be dislodged whenever the bellows are pulled out, and settle on the plate or film.

In many double-extension cameras the half-way fold of the bellows has a hook or loop attached to it, which is left hooked on to the lens front except when use is made of the double extension. If this is not kept hooked in single-extension work, the bellows will not be pulled sufficiently forward away from the film, with the result that the back folds will intercept some of the light, cutting off the picture and giving a wide blank margin all round.

BIRD PHOTOGRAPHY WITH A STILL CAMERA

Ian Thomson, M.B.O.U., F.R.P.S.

Author of "Birds from the Hide"

In an earlier chapter detailed information is provided on the subject of photographing wild animals of varied species. Here, another fascinating aspect of nature photography is discussed, that in which the camera is used to capture incidents and phases in bird life. This article is illustrated throughout with the author's photographs. It is followed by two others—on bird photography with a miniature camera and on bird cinematography

THE application of the camera to the recording of bird life—whether at the nest, that is, during the breeding season, or at other seasons of the year—has reached such a high standard of perfection and by such different methods that detailed descriptions of them are extremely difficult. Difficult because most of these methods, as a rule, merge together at some time or other if this kind of work is undertaken with the thoroughness which it is absolutely necessary to employ. This will be realized only too well when the novice decides to put his hand to such an interesting art and finds that the road to success is pitted with many potholes which will often dishearten him to a degree, when he will wonder if the game is "worth the candle." For a game it is, or perhaps it should be called sport.

The writer has in his time done a fair amount of the other sporting pursuits, such as fishing and shooting, but these pale with the excitement which is ever present to the photographer concealed in his "hide" when the bird or creature he has set his mind on recording comes within the range of his camera, and he is able to obtain a picture or pictures without harming the subject which he hopes to study, and can go on studying. Whereas with the gun, when the

quarry has been killed, no more of the life story can be learnt.

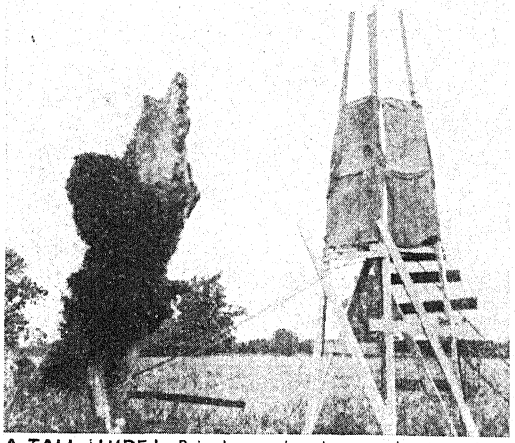
Natural history workers with the camera have many different types of " hide." Some of these are most elaborate, heavy and difficult to carry about, but when erected they are rigid to a degree and stand up to the worst of the elements. Others are light, flimsy affairs; but where long distances over rough country have to be traversed and aid to carry extra weight is not forthcoming, then the light type is the only one to use where every pound of weight counts. Some workers do not use a standardized form of " hide," but build from materials available in the neighbourhood—such as branches cut from trees, stakes, fencing posts, etc., etc., bound together securely by stout string or rope, and covered with sacking or other similar material. As a rule the whole " hide " is covered with the herbage where the bird to be worked is nesting or visits, and securely held in position by string, rope or wire so that it cannot blow away or become detached whatever weather may be encountered. There are times when such " hides " are



ON THE NEST. The sitting hen is one of the easiest birds to photograph so long as care is taken in the preliminary arrangements not to scare her permanently from her eggs. Above is an expert's " snap " of a blackbird on the nest
Exposure 1/10 sec. at f11



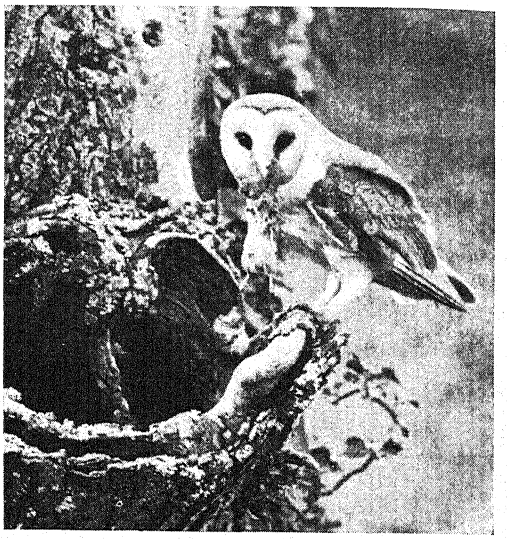
GOLDFINCH IN CLOSE-UP. This cock goldfinch at his nest seems to have been completely distracted by the cries of his hungry offspring from contemplation of the " hide " from which this fine study was taken. All the essentials demanded of a good bird photograph are here : perfect lighting and focussing, and the inclusion of leaves and branches of the tree, from comparison with which an idea of the bird's size may be gained
Photos, Ian Thomson; exposure 1/25 sec. at f8



A TALL 'HIDE.' Raised on poles about twelve feet above the level of the ground, the "hide" shown above was especially constructed for the photographing of a barn owl's nest in the ivy-covered hollow tree-stump beside it

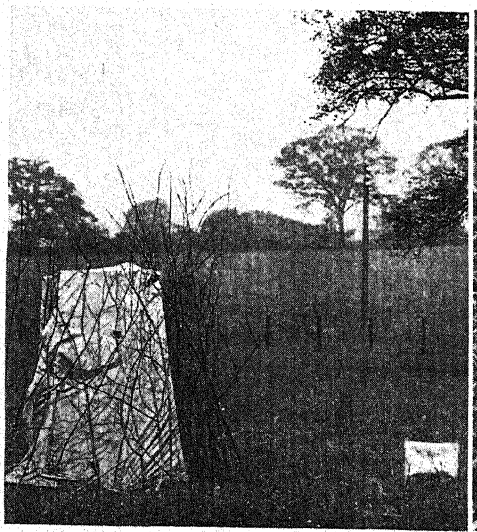
quite useless; the ingenuity of the photographer is then brought into play.

On one occasion a barn owl's nest was found in an old stump some 16 feet from the ground with nothing near it where a "hide" of the ordinary type could be used. It was decided to build up to and above the level of the entrance hole. To do this, two local carpenters brought four 4-in. by 3-in. poles 20 feet in length, nailed cross members diagonally up to a platform, which was made by bolting the poles together almost 12 feet from the ground and nailing broad planks across these to form the floor on which the camera and worker could stand firmly. Sacking was nailed round the sides and top so that a man six feet in height could stand upright inside it. The question of the whole erection toppling over was overcome by spreading the base so that it was wider than the top. It had been decided that this was a better method than



IN UNUSUAL POSE. A rare sample of the kind of photograph obtained from the "hide" shown on the left above—the barn owl returning to its nest in the hollow stump with its prey, a field vole, in its beak

Exposure 1/20 sec. at f4.5





SNAPPING THE LAPWING. The photograph on the right, above, of a lapwing and its eggs was taken with an exposure of 1/25 sec. at f11 from the thinly disguised 'hide" seen on left. The upturned camp-stool at bottom right of left-hand picture marks the position of the eggs, and serves to show how close the "hide" can and should be to the subject to be taken

Photos, Ian Thomson: exposure (photo on left) 1/10 sec. at f16

sinking them in the ground, as it would then be impossible to move the "hide" if it were thought necessary to do so.

At other times wire netting has been found a very useful material with which to work, this being interlaced with reeds, branches, or heather, and then securely bound to posts driven into the ground.

Sometimes where rocks are found it is impossible to drive posts to any depth at all. In such a case methods must be employed suitable to the site. Heavy stones may be piled round the material of the "hide," or sometimes



'HIDE' DISGUISED. For photographing the timid French partridge seen on left the bare canvas of the "hide" has to be well covered with foliage, as shown above, where it has been given the true semblance of a bush



PARTRIDGE DISTURBED. Even with the well-concealed "hide" shown above the suspicious French partridge could not be approached without causing her some fright; possibly the click of the shutter caused her to turn her head in this photograph
Exposure 1/10 sec. at f11

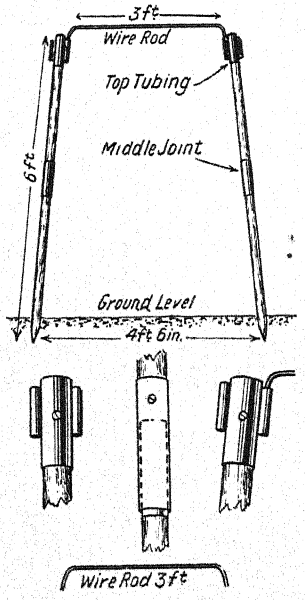
even the whole thing may have to be built of rocks and stones until it looks like the stone walls of the North.

Birds vary very much in their reactions to a "hide," and many will pay very little attention to one which is not hidden at all, provided it is put up slowly and carefully. By this is meant the gradual moving of the "hide" from a distance and at a low height to the spot from where it is intended to start photographing.

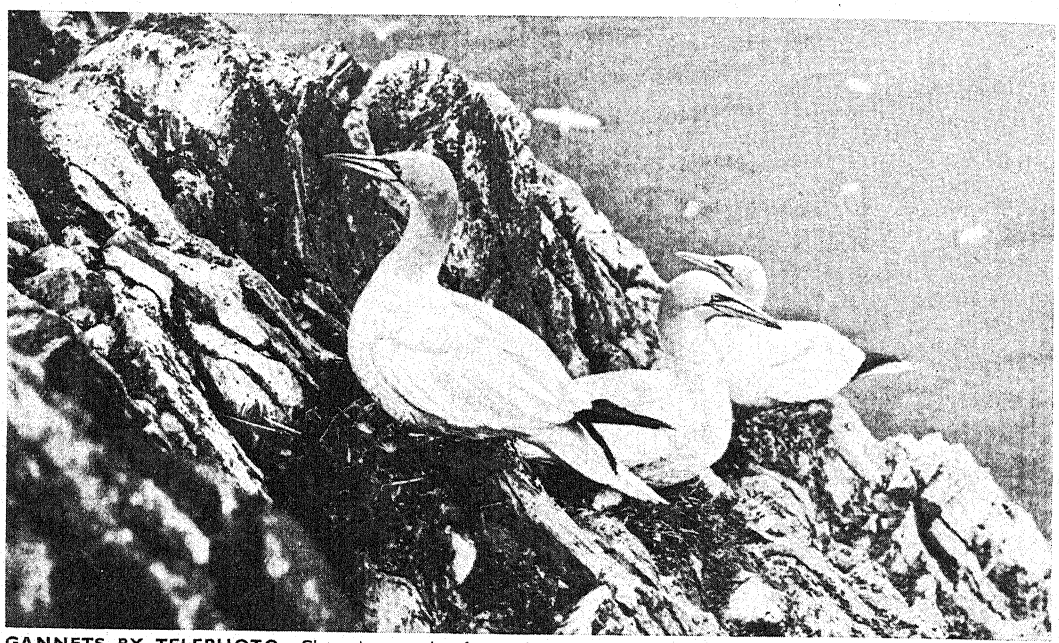
The writer uses a light but fair-sized type of "hide" which is six feet at its full height. The posts are made of poles 1 in. in diameter and 3 ft. long, which can be bought from any wood shop. Telescope tubing is used for joining these two pieces together, two sizes of tube being used so that one is a tight fit in the other. If tubing is bought which just fits over the poles, it means that only four poles in each "hide" will have to be tapered in order to take the smaller tubing which slips into the larger. (The diagram in this page should be consulted on this point).

Each piece of tube need not be more than 5 in. in length in the case of the larger, and less in the case of the smaller, as the larger must take both the pole to which it is attached and the other which slips into it. At the top of the poles shorter pieces of the tube are attached, and on to these two smaller tubes are soldered into which steel or iron rods are placed to form a framework for the top of the "hide," and also to hold the whole together and square. These smaller tubes must be soldered with silver solder, as ordinary soft solder will not satisfactorily stand up to the strain.

The rods are bent so that the angle is not a right-angle, but slightly more obtuse; by so doing the top of the "hide" is narrower than the bottom. This gives more room at



SKELETON OF THE HIDE. The size and method of joining the "hide's" framework, explained in text in this page, is shown diagrammatically above



GANNETS BY TELEPHOTO. Close photography of sea and cliff birds that nest in inaccessible places is often not less physically dangerous than artistically difficult. Such work as this must be done without a " hide " but using a telephoto lens

the base for the camera legs and the worker, and is less bulky on the top where the space is not required.

The actual tent is made of casement cloth, and can be either brown or green. Small holes can be cut, through which the camera lens projects, and other holes are made, through which the worker can watch his subject.

The diagram (p. 173) explains itself as to the construction of this very simple " hide " for ordinary use. Such an erection can be put on the top of step-ladders, and can be made higher by binding longer poles to the existing ones ; but as each nest may require different treatment the photographer must work out the best means at the time.

The photographer starting the study of bird life with a camera must be made to realize that he is embarking on a science which will bring him many hours of untold joy, but it cannot be successfully undertaken without that care and consideration for his subjects which is the first and foremost essential to that success. This cannot be too strongly stressed. It has been indicated in the necessity of gradually erecting the " hide."

Take as an example the nest of the lapwing or green plover, so well known to most people even if they only be the gourmets who are now bewailing that they cannot obtain the eggs now as in the past, and have to eat gulls' eggs instead ! This bird lays its eggs in the open fields. It would be madness to put a " hide " at once in the position suitable to work this bird, as it would most certainly desert. When the eggs are found, they should be left until the bird has been sitting on them some time, as birds are usually more attached to their nests when the chicks are well-formed in the shell than when the eggs are fresh. Some distance away—say 25 feet —put a low heap of turves or branches, held securely.

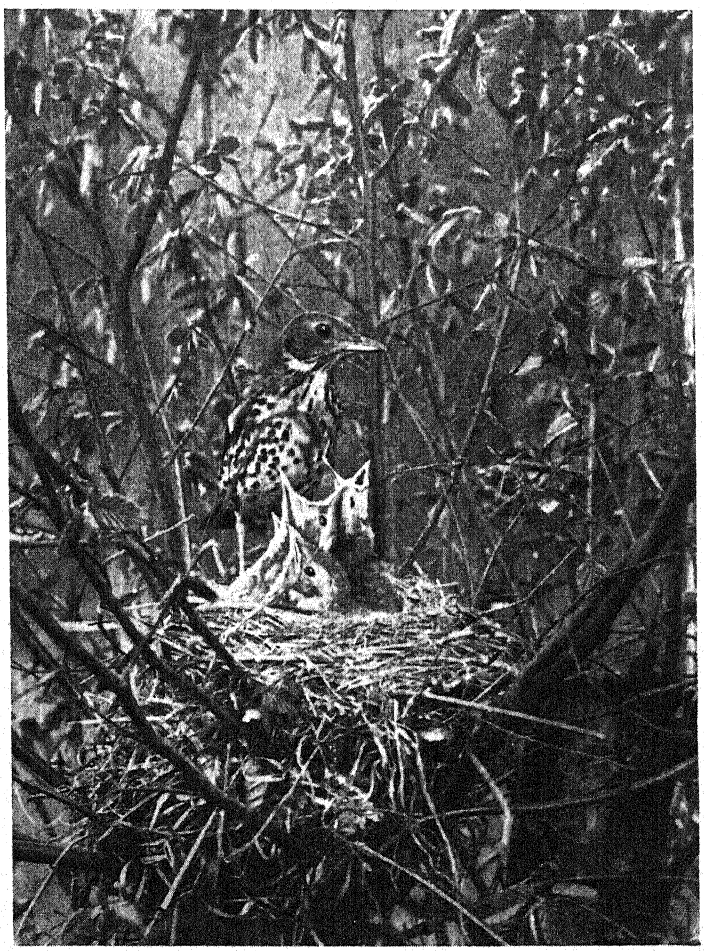
Getting the 'Range

When the bird takes no heed of this (it is better to watch her reactions and to see her safely back to her eggs), gradually increase the heap and move it closer. When it is, say, four feet in height, then put a low "hide" underneath the heap. By this is meant, use the four top members and rods of the framework and put the tent over this, turning up the surplus and working it tight all round with stones or turves, or any heavy material handy. It is most necessary to do this, as birds hate movement more than

noise, and a flapping "hide" disturbs them a great deal at first, if not all the time; and it is the early stages that decide whether the efforts are going to be successful or not.

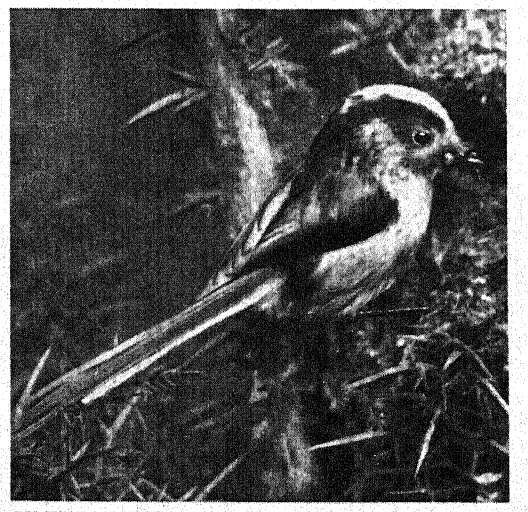
For a bird of the size of a lapwing, the writer considers the "hide" should be about eight feet away from the nest. This question of distance is a very controversial one, as there is always friendly discussion on this subject between those who use telescopic lenses and those who do not. The writer, in most cases, uses the ordinary lens in preference to the tele-lens and, in consequence, has to work closer; but this will be mentioned later.

When the "hide" has been moved to the required distance and the bird is apparently quite oblivious to it, then it can be raised, if necessary,



NEST CONSTRUCTION CLARIFIED. Here greedy song-thrush fledglings are beseeching an anxious parent for food—a typical spring-time study. The construction of the nest is clearly shown in this photograph

Photo, Ian Thomson; exposure 1/25 sec. at f8



AT THE FRONT DOOR. Above is seen a remarkably clear study of the long-tailed tit at the entrance to his beautifully constructed lichen nest, to which he is bringing a tit-bit in the form of a worm

Photo, Ian Thomson

to a height which will take the worker and his camera in comfort.

With such a subject as the lapwing, 4 ft. to 4 ft. 6 ins. should give plenty of room, with the remaining 18 inches in the ground.

Much has been made of the "hide" in this article, but it is the most important item in the bird photographer's outfit; even more so than his camera, because if it is not done correctly, or treated as it should be, then it will be impossible to achieve the results of which the camera is capable.

Cameras to Use. The kinds of camera for "still" work can be almost legion, but the serious worker should eventually settle down to a type of apparatus which to the uninitiated seems too bulky and old fashioned



NEST REVEALED. In bird photography it is not only the appearance of the bird itself, but also the construction and position of its nest that should be recorded. These are particularly well shown in the above picture of a cock bearded tit at its nest. Note the tactful removal and bending away of grasses
Exposure 1/25 sec. at f11

when so many small and perfected types are now to be found in the market.

The writer has always found that the rigid stand camera is the most useful for bird work, the smallest size of plate or film to use being that known as quarter-plate, that is, $4\frac{1}{4} \times 3\frac{1}{4}$ in. From such a size big enlargements can be made, and if the novice would study the work shown at the leading photographic exhibitions, he would be amazed at the examples shown by the leaders of this science. Almost every photograph has been enlarged by many diameters.

There are still workers using cameras with plates of larger size; but, owing to the cost and bulk, quarter-plate should answer the purpose of the most critical.

The actual type of camera does not matter, as long as it is very rigid when erected. This is most necessary, as the lenses used are heavy and there must be no sign of vibration. Where possible, it is the ideal to have a camera that racks back for focussing purposes. The reason for this is that when the lens is pushed through the front of the "hide," and the whole is covered up with herbage, any movement of the front of the camera may displace this across the lens, apart from disturbing the birds.

It has been mentioned that birds do not like movement. This is another point in favour of the camera that racks back, and also that refocussing can be done at any time. This is a very good plan to adopt, as when the actual bird itself can be seen on the focussing screen, critical sharpness in the final result can be a certainty. The old-fashioned square bellows camera is a type which was excellent in this respect, and its solid wooden front gave complete rigidity. These are hard to find, and their weight to the average worker is much against them.

A Useful Attachment

A swing-back is also of great use to the serious worker, and most of the field cameras, as they are called, have this. By this attachment the focussing screen can be tilted forwards or backwards, and can bring into focus areas not sharp at the ordinary position. Any good-class camera dealer can show such an apparatus, and the readers will immediately understand the principle whereas any amount of written explanation would only tend to "tie up" the beginner.

Most people who start bird work think that the reflex type of camera is the ideal. This depends on the work to be undertaken, but most photographers—even when they have a reflex—use it less as the camera was originally intended and more as a stand camera, and focus from the back. This kind of camera only racks forward, and also the shutter is far too noisy for average work.

It is ideal for flying stuff and very fast, but most of the work published and exhibited is done with as slow an exposure as it is possible to use without showing movement of the bird, and with a shutter which is particularly silent or, of course, the ideal, silent. This ideal is very nearly impossible except when the bulb position of a shutter is used. With this the leaves of the shutter can be opened and shut without a click, but it requires great experience to work with this, and it is inadvisable for the novice to attempt it. There are almost silent shutters on the market, and these can be adapted to take different lenses and fit on to any of the field cameras.

The question of lenses is a difficult one to advise, as it is so controversial; but most workers use lenses varying from 6-inch to 8-inch focal length, and the writer has found that the 8-inch has been, all round, the most useful. This lens can be used with half-plate and, having larger covering power, will therefore give a bigger image than a 6-inch; and that being so, it is not necessary to be so close to one's subject, but the longer the focus of the lenses the shallower the depth of focus of that lens. By this is meant that the area of critical focus of the lens is narrower the longer the focal length. This can be overcome by stopping down; this reduces the size of the opening of the lens and increases the depth of focus, but lets in less light, making a longer exposure necessary. This is all to the good if the light is bright, because much more of the eventual picture will be in critical focus—an ideal to be aimed at every time.

At the present time there are many very fine lenses on the market, but the tendency is for them to be made with very large apertures. This is not at all necessary for bird work, except in poor light and for fast work, and when one looks back on the beautiful results of the early workers who were using lenses of small aperture and of simple formulae, it surely becomes obvious that the large-apertured lens is not an essential, though it is, of course, at times a very useful component.



REDPOLL REGARDANT. An interesting bird habit is here recorded, showing that ornithological as well as photographical knowledge is needed in bird photography; the redpoll above is stretching out its wings to shield its young from the glare and heat of the sun

Exposure 1/25 sec. at f8

This brings us to the telescopic lenses. Many look upon them, if not as the only type of lens to use, anyway as a necessity. The writer looks upon them as a necessary adjunct, but not to be acquired until the other type of lens has been mastered. The worker with a tele-lens has to be very much an expert if he is going to get first-class results. Many of the so-called results obtained by these lenses are deplorable, because the users have not realized the shortcomings of the apparatus; the greatest of these, to those who use the other type of lens, is generally foreshortening. I have seen results taken at 25 feet of the lapwing with one of these lenses where the bird appeared to have no legs, due to this fault; whereas the same bird with the "hide" moved close was shown almost as a studio portrait.



CLEARING THE VIEW. This photograph of a grasshopper warbler at its nest shows particularly well how the grass and undergrowth around the subject should be tied back to provide a clear path for the lens

Exposure 1/10 sec. at f16

Plates, although bulky, are more satisfactory to work with than films, though flat films and film packs run them extremely close and, where weight is a prime consideration, may be most suitable. The negatives, however, cannot be treated in the dark-room so easily if any blemishes have to be eradicated.

BIRD PHOTOGRAPHY WITH THE MINIATURE

This article, illustrated in part with the work of the author, Mr. W. B. Redmayne, states the many advantages of the miniature camera for bird work, and gives easily followed instructions for its use in varied circumstances

The miniature camera has many advantages over larger apparatus for photographing birds :

(1) It is easier and quicker to work. Half a dozen exposures can be made in as many seconds ; (2) The depth of focus is so great when using ordinary lenses ; (3) The number of exposures that can be made is so much greater ; (4) It is so easy to focus and adjust, and is particularly efficient for high-speed work ; (5) The fine range of lenses available makes it suitable for any kind of natural history work. Lastly, only a very small " hide " or tent is required.

The framework for the " hide " may be made of bamboo canes or metal tubing, such as that used for encasing electric wires. If the latter, it should have a fixed oblong top about three feet by two feet, with a pin at each corner to fit into four upright tubes about six feet in length. Any kind of material, such as casement cloth or canvas of neutral colours, will do for the covering. There should be an opening at the back from top to bottom with tapes or fasteners attached to fasten oneself in.



FAMILY FROM SEVEN FEET. Here the black-headed gull parents and chick are seen taken at a distance of seven feet by a miniature camera—a difficult feat without alarming the birds

Photo, W. B. Redmayne : Leica, f9, 1/100 sec., Agfa Iso.

On the front side a small hole is cut for the lens and finder, and another about one inch square nearby to be used as a peephole. The whole thing can be made for a few shillings. There is, in my opinion, no need to camouflage the " hide " by covering it with masses of foliage.

When photographing birds like curlews, in open fields or on moors, approach gradually. First put the " hide " up 30 or 40 yards from the nest, each day moving it nearer, until within seven or eight feet. Four or five moves are generally sufficient. For birds nesting on the seashore the " hide " may be put up ten or twelve yards away to begin with, and two or three moves will be sufficient if the eggs are " hard sit." For birds nesting in gardens, the " hide " may be put up close to the nest at once. For small birds a 9-cm. or 13.5-cm. lens is desirable, but all can be taken with a 5 cm. if within three and a half to four feet away. I use only 5-cm. and 9-cm. lenses of the Leica camera for all my work.

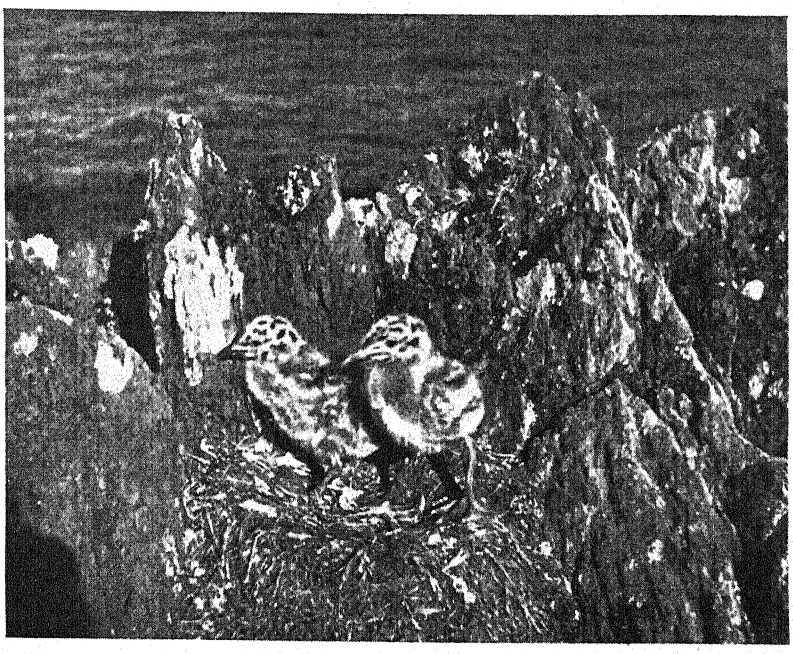
A good substantial tripod is advisable, on which the camera may be fixed, or for resting the hands on. The first thing to notice is how the parent birds approach the nest. The camera should be focussed on the spot where they usually alight. If they keep varying the position, a happy medium must be chosen. In such cases a short-focus lens gives good depth of focus, and to hold the camera in the hands resting on the tripod top enables one to alter the position quickly.

In a good light, for nests in foliage or other dark surroundings, an exposure of 1/30 sec. at *f*4.5 stop with fast films should be about right.

For light-coloured birds on the seashore 1/200 sec. at stop *f*6.3 is sufficient. Dark-coloured birds in a field require about 1/30 to 1/40 sec. at *f*4.5, or 1/15 to 1/20 sec. at 6.*f*3 with films the above speed.

The best time to photograph small birds is when they are rearing their young. Here the miniature camera has a great advantage, as frequently several shots may be made each time the parents visit the nest.

The best time for birds nesting on the ground, such as gulls, terns, curlews—where their young ones run directly they have hatched out—is just before they are ready to hatch out, for then the old birds are more ready to come to the nest. Many interesting photographs may be taken of young ones just emerging from the eggs.

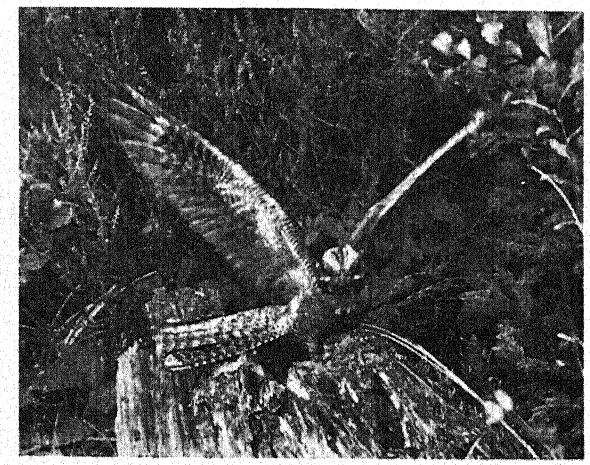


BABY BIRDS WITH A MINIATURE CAMERA. Above is a delightful snap of gull chicks waiting for their parents to return to the nest with food. The contact print from which the above enlargement was made is reproduced on right

Taken with a Compass camera, 1/50 sec., f4.5



Trying to obtain snaps of birds in various characteristic attitudes and movements is one of the most fascinating parts of bird photography. For instance, such birds as terns and gulls usually alight close to the nest with wings outspread. There is just one moment when the wings are at the top when delightful pictures may be obtained if rightly timed. Here the miniature camera scores again, owing to the number of shots that may be made, and the best of them sorted out.



NIGHTJAR ALIGHTING. Here the miniature camera has acquitted itself well in a study of great difficulty, for the nightjar alights in a sudden flurry of wings that needs very high-speed shutter work

Photo, W. B. Redmayne Leica, 1/500 sec., f3.5

Strange to say, one of the easiest birds I ever photographed is one of the shyest—the corncrake, a bird that is seldom seen but often heard. It was most interesting to watch how she approached her nest. Nothing indicated her approach until her head popped out over the nest, but she was most obliging as a subject.

One of the most difficult birds I ever photographed was the mysterious "nightjar." It sleeps all day, hiding itself simply by camouflage on branches of trees or in open clearings. It flops on its eggs—for it builds no nest—with whirlwind speed. I have spent hours trying to catch some of its characteristic actions; but even with my lens opened to /3.5 and working at 1/500

sec. with super-fast film, my pictures were blurred; but it was worth watching and worth trying. I succeeded, moreover, in getting one picture showing the bird's characteristic gape.—*W. B. REDMAYNE.*

BIRD PHOTOGRAPHY WITH A CINE CAMERA

Here, after general remarks, are described in detail the experience and ingenious methods of the author, Mr. G. L. Hawkins, in making his film "Under the Eaves"

Bird photography, or cinematography, is a branch of animal photography (*q.v.*), which usually involves one or two special considerations which do not concern the photographer of other more ordinary subjects. The lens equipment will include one or two extra-long-focus telephoto lenses, and the operator will need some form of hide in most cases.

The hide may be quite a formidable construction. Birds, once they get used to the sight of such an object, cease to concern themselves with it. Movement and noise are the two things some birds never get accustomed to. So the cine camera must have a reasonably silent motor, and the photographer, once inside his hide, must stay there for long periods. My own lens equipment for 16-mm. bird photography consists of 1-in., 2-in., 3-in., 4-in., and 6-in. lenses, all of the biggest aperture obtainable.

Of course, birds vary in their nature, as do all animals. Some birds are more timid than others. Some become most timid at nesting time. Others become so intent upon their own family affairs that they grow, to some extent, almost immune from outside influences such as the proximity of a camera. So the successful bird photographer will first study his subject.

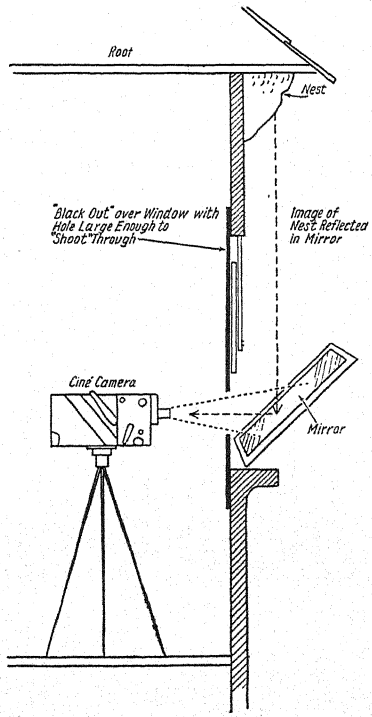
He will discover by practical test how close he can approach them. He will run his unloaded camera within hearing of the birds to see if they get used to it. Above all, he will study their lives until he knows every detail of their daily doings, even to the extent of making a timetable of their activities.

Every spring I see, under the eaves of my home, one of the most delightful of natural-history subjects. I refer to the house martin, common to most parts of the British Isles.

To photograph them building their nests and conducting their intimate family affairs presented one or two unusual problems. The sight of a human being at the window beneath the nests usually frightened them away.

Even supposing a hide could be constructed, the position of the nest, almost vertically above, seemed to preclude any possibility of using a camera successfully in such an inaccessible position.

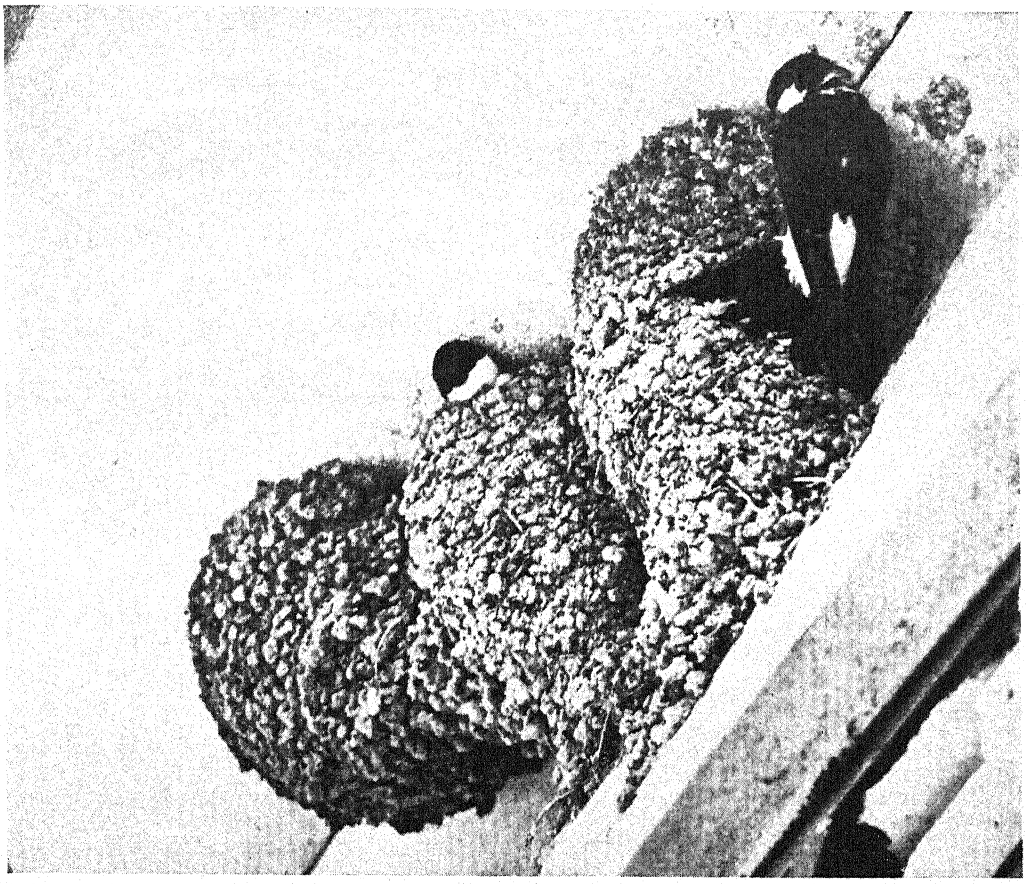
However, for one whole season—that is, from the arrival of the birds in April until their migration in September and October—I spent enough time watching them to become conversant with their habits. I made no attempt to expose film that summer. I made careful records, with times and dates.



HOW TO 'SHOOT' THE HOUSE MARTIN. The natural nervousness of this migrant together with the inaccessibility of its nest makes some form of "secret" photography essential. Above is shown diagrammatically an arrangement, described in the text in this page, by which a continuous record of the martin's movements can be kept, unobserved

Much of my observation was done in a mirror which I fixed at a suitable angle outside the window above which was a cluster of martins' nests. Thus I was able to sit in the room and observe their movements.

I constructed, the same year, a large tripod of scaffolding near one building with access to its top by means of a ladder. Upon this I mounted a camera stand with universal tripod head. The object of this was to give me a viewpoint level with the nests. This construction stood there throughout the summer and succeeding winter, unused save for periods when I was myself perched upon



HOUSE MARTINS AT HOME. This " under the eaves " still picture of house martins at their nest was taken with a miniature reflex camera with a reflecting prism attached to the lens in the manner explained in the text in the following page. The effect is the same as that obtained by the means illustrated diagrammatically opposite

Photo, G. L. Hawkins

it with empty camera, making observations and getting the birds used to my presence and that of the camera.

Many viewpoints contribute in making a film interesting, so I arranged a viewpoint from indoors. This consisted of an optically true mirror fixed at such an angle that I could shoot the scenes, reflected in the mirror, from inside the room. In this case the room was my hide. When working with a mirror, of course, the focussing scale must be set for the " real " total distance from camera to mirror and mirror to nest (the dotted line in the diagram). In the same room, and in others, I arranged points for fixing the camera to shoot directly up at the nests, the camera being, for these shots, screwed to a tripod head, which was itself clamped to a board which could be securely fixed on the outside window ledge. Six months of careful planning of viewpoints, and of study of the birds, put me in a position to start work the following April.

Every aspect of the life of the house martin was photographed from many, sometimes from all, of the prearranged viewpoints. Further, shots were made of the birds collecting mud on their beaks at the nearby river bank. Other incidentals photographed were : catching insects in flight, catching feathers for lining the nest, and perching on the wires which I had stretched outside the house near the eaves to give the birds an alighting place.

Altogether about 4,000 feet of 16-mm. film was exposed. A shot of the inside of the nest with its four eggs was made by trick methods. A nest was photographed close-up. the film wound back, then re-exposed in the studio upon a carefully arranged scene made

up of feathers and eggs artificially illuminated with light on the eggs but none elsewhere. By careful superimposition, getting the improvised scene in the right place in the frame and fading in and out, the desired effect was obtained; that of giving a sort of X-ray picture of the inside of the nest.

The making of the film was, of course, on the editing bench. Everything that ever happened had been photographed several times from different viewpoints and with different lenses. So, from perhaps ten or more film strips it was possible to make one really interesting sequence of the particular episode portrayed in each. So on throughout; cross-cutting and eliminating, until, in the end, a 400-ft. film of some merit was produced.

No film is really complete without its "stills." These were made, in this case, with a miniature reflex camera with a reflecting prism attached to the lens. In effect this was the same as using the mirror for the cine shots. The reflex camera was mounted on a ball-and-socket head with clamping screw. The prism could be revolved and clamped in any desired position. The still reproduced in page 181 was taken thus.

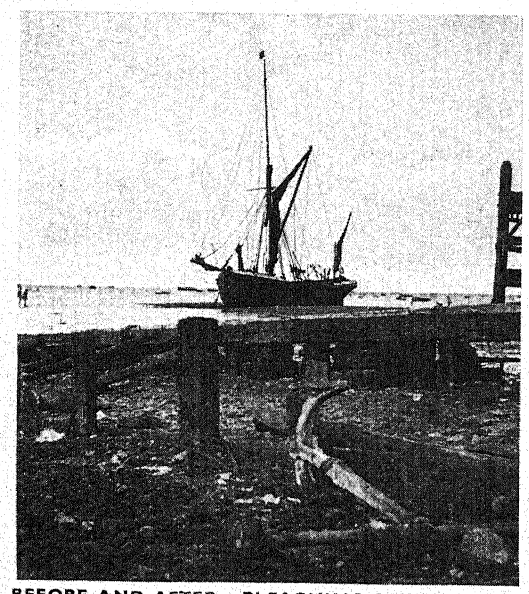
The film "Under the Eaves" is available from the National Film Library of The British Film Institute.—*G. L. HAWKINS, F.R.P.S*

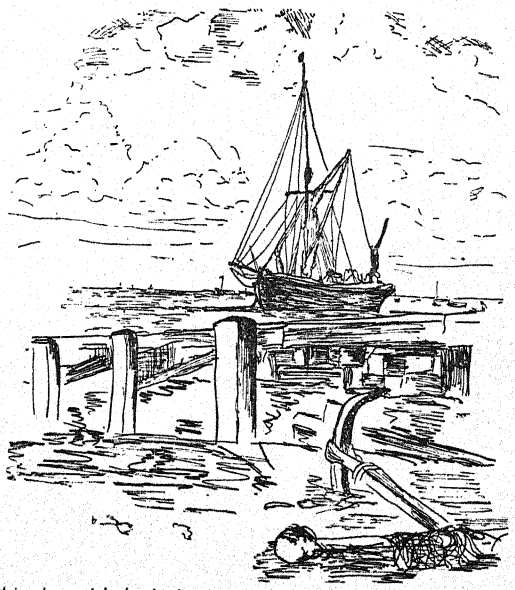
BLACK EDGES. To obtain black edges to bromide prints intended for competitions or exhibition purposes the usual way for enlargement purposes is to cut a piece of opaque card slightly smaller than the final trimmed size of the enlargement, and then, either before or after the exposure is made, place it in good contact on top of the bromide and, with the negative removed from the carrier, expose the remainder of the bromide to the white light for a second or two. On developing out the edges will be black. If contact prints are made from film negatives, the film is cut slightly smaller than the paper, which gives the same result.

BLACKING. The interior of cameras and dark slide and the inner surfaces of lens tubes are coated dead black to prevent reflection of light, which would fog the sensitized material.

Occasionally tubes and cells of lenses wear bright after long use, and they should be recoated with matt black. "Nigrogene," made by the Vanguard Manufacturing Co., is widely used, or a good dead black may be made by mixing finely powdered lamp black with enough gold size to bind it.

BLEACH-OUT PROCESS. The bleach-out process is a method of producing line drawings from photographs. The drawing is done upon the surface of a





BEFORE AND AFTER BLEACHING-OUT. As explained in the article beginning in this page, the reproduction of line drawings by the "bleach-out" process is a useful art in commercial work. Above are, left, the original photograph, and, right the resulting line drawing

Photo and drawing, Joan Charles



'PALE' AND 'BLEACHED.' The photograph on left is of a pale print, produced as explained in this page, and bearing the Indian ink lines on the main outlines on the building. On the right, the " bleaching-out " process is complete, and shading has been added

Photo and drawing, Joan Charles

photographic print, the silver image of which is finally bleached away. This process is extensively used in making commercial illustrations for catalogues and the like, as well as in illustrating periodicals, for which line-blocks are considered most suitable. But there is no reason why it should not be taken advantage of for purposes of greater pictorial merit.

Prints on matt-surface paper are usually preferred by those who employ the process regularly, but its success actually depends more on attention to certain details of processing than upon the particular character of the paper, with the sole exception that, if the drawing is to be done in pencil, a paper having the " tooth " of matt or rough surface is naturally preferable. Sufficient exposure having been given to the print to show the fainter detail without " forced " development, the developer is diluted with several times its normal bulk of water, and the print is allowed to remain in it only long enough to make those high-light details visible. The image will then be of a pale character, perhaps slightly greenish in tint, upon which the work of drawing can be plainly seen as it proceeds.

After rinsing and fixing as usual, the print should be washed for not too long, say from 10 to 15 minutes. In hard-water districts long washing deposits scum on the surface, which makes drawing difficult. Before clipping the print up to dry it is preferable to wipe off all surface water, and any scum with it, with a clean rag or sponge.

Ink drawing must be done on the dry print with " fixed " Indian ink, in view of the subsequent wetting, but almost any kind of pencil may be used to produce sketchy effects. As soon as the work is finished, the image is removed by any kind of reducer (*see* Reducer), or the print can first be soaked in a solution of iodine in potassium iodide, and then in a plain hypo bath. Care must be taken not to touch the drawing while it is wet, and after a short rinse it is clipped up to dry again.

BLUE PRINT. A blue print is a form of photo-print which is produced by the action of light upon a paper prepared with a ferric-salts solution. In this process the ferric salt is converted to the ferrous state, and there is a precipitation of Prussian blue by ferricyanide of potassium.

Blue prints are known technically as negative cyanotypes, and they are used principally in engineering when copies are required of working drawings and plans. A tracing is made of the original, and this is placed with a sheet of the sensitized paper in a glass-faced frame and exposed to light. The print is then washed in water, the result showing the lines of the drawing in white on a blue background. Blue-print paper is marketed in a variety of cut sizes

and in rolls, and is available in three grades —fast, medium and slow.

For the photographer cyanotype printing offers certain advantages, especially as it is a simple matter to prepare the necessary material. Ordinary smooth writing paper forms a suitable basis, and this is coated with two solutions, the formulae of which are as follows :

(*a*)	Potassium ferricyanide	8 parts
	Water	50 parts
(*b*)	Ferric ammonium citrate	10 parts
	Water	50 parts

These solutions are mixed in equal parts, and they must be filtered and kept in the dark. The paper is treated with it by means of a brush, which is worked first one way and then the other in order to secure an even coating. The colour of the solution indicates whether it has been correctly made up ; it should be of orange-red or yellowish hue.

When the paper is dry it is placed under the tracing and exposed until the shadows become bronzed. The process is finished by rinsing the print for about 15 minutes. An increase in contrast can be obtained by over-printing, and by using a potassium bichromate 10 per cent. solution.

Another form of blue print, known as a positive cyanotype, gives blue lines on a white ground. The paper used in this process is coated with a mixture of three solutions which are made up as follows :

(1)	Gum Arabic	20 parts
	Water	100 parts
(2)	Ammonio-citrate of iron	50 parts
	Water	100 parts
(3)	Ferric chloride	50 parts
	Water	100 parts

These solutions are then mixed in the order and proportions as given below :

Solution 1	20 parts
,, 2	8 ,,
,, 3	5 ,,

In mixing, the solution changes from a thin state to a thick condition and finally returns to a clear liquid form. The paper used must be sized, and the solution is applied to it with a broad brush. After the exposure has been made the paper is treated with a developer, which is applied with a brush. The developer is :

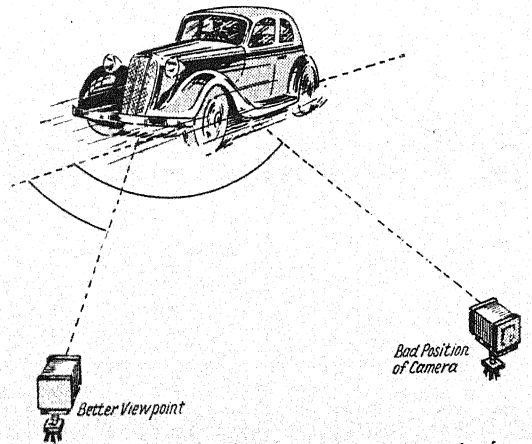
Potassium ferricyanide	20 parts
Water	100 parts

Immediately the image appears the print must be rinsed in water, immersed in a bath of dilute hydrochloric acid—one part to ten parts water—and, as soon as the ground appears white, finally washed and dried.

BLURRING. If a print shows a blurred image, even though the camera was correctly focussed, the defect probably arose from movement during the period of exposure, on the part either of the subject or of the camera.

When working at shutter speeds slower than 1/25 second, it is always advisable to mount the camera on a tripod, or, failing that, to place it upon some rigid support. Even at faster speeds, when the camera can safely be held in the hand, it is essential that the shutter should be released smoothly, without jerking the camera. In the past, with certain makes of camera, smooth shutter release was none too easy on account of the inaccessibility of the lever, but of late manufacturers have been paying more attention to the position of the shutter release. In new models this is seldom found on the lens mount, but rather in the form of a press-button or trigger on the camera body itself, thus doing away with the tendency of many beginners to press the entire camera front down when pressing the shutter release.

Swiftly moving objects present certain difficulties to the beginner, and a single-speed shutter, though optimistically termed " instantaneous," will be of no use in photographing such things as express trains or racing cars. For this kind of work shutters



BLURRING AVOIDED. In this diagram the necessity for a three-quarter front view of a moving subject is made clear

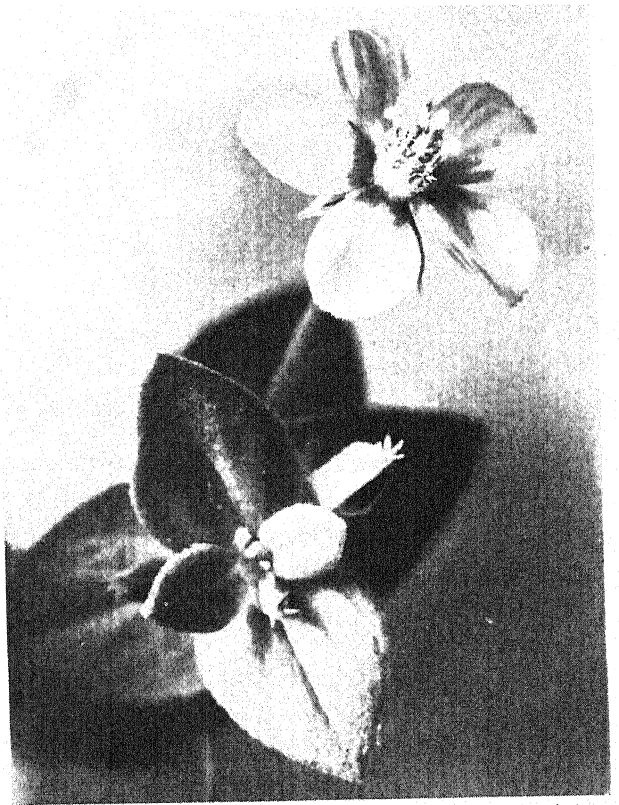
working at 1/300 second or even less are essential. (*See* Action Photography.)

Apart from this consideration there are certain rules that should be adhered to when photographing fast-moving objects. Moving objects have the characteristic of appearing to move at different speeds when viewed from different angles. To the observer an object appears to be moving at its maximum speed when passing at right angles across the field of vision—that is to say, broadside on, and this speed apparently decreases as the line of motion is swung round towards the observer.

Therefore, to get as sharp a picture as possible of moving objects the camera should be placed obliquely to the path of the object and facing it, as shown in the diagram opposite.

Even with a very fast shutter it is no easy matter to photograph really swiftly moving objects with complete absence of blurring. The experienced photographer gets his sharp photographs of racing cars by a technical trick known as "panning" the camera—that is to say, he swings the camera in the same direction as the object he is photographing. The subject should be picked up in the finder while it is still some distance away, and the camera moved round in an arc, keeping the subject well in the centre of the finder all the time, the shutter being released at the desired moment. This needs a little practice, but proficiency will soon be obtained, and the resulting photographs give a fine impression of speed, with the subject clearly defined and the background blurred.

With cine cameras, when using normal shutter speeds, never attempt to take fast-moving objects moving at right angles across the field of view, or the result will be nothing but a dazzling blur. The three-quarter view is far better for fast objects.



A PERFECT SPECIMEN. The qualities so much to be desired in a botanical photograph—that it should not only be a pictorially effective study, but also show clearly the characteristics of the species from the botanist's point of view—are exemplified in this fine photo of a scarlet pimpernel

Photo, David Charles ; exposure 60 secs., f32, Ilford S.G. pan. plate

BOTANICAL PHOTOGRAPHY.

Botanical photography—*i.e.* the photography of plants for study or instruction in botany—differs from the making of "flower studies" in several important respects. Although single specimens are usually dealt with, the work is actually a greater test of ability.

Many of the subjects are small weeds, whose extreme frailty and liability to wither rapidly makes it essential to photograph them as soon after picking as possible. The work should be done where the chances of the least draught or of vibration are absent. Although small stops must be used in the lens to obtain depth of definition on these small close-up subjects, and time exposures are the rule, they must be kept to minimum, because delicate petals and stalks will frequently show a tendency to droop, especially under the warmth of electric light.

These considerations are exaggerated by the desirability in many cases of making negatives the same size as, or even on a somewhat larger scale than, the subject itself. The same reasons often prevent the use, however desirable technically, of a

full-correction filter. Provided one has a camera of really long extension, both greater "depth" and better perspective of small specimens are obtained by the use of a lens of four to six inches focal length than with a "miniature" lens of two or three inches.

Characteristics of the Subject. The problems of this work resolve themselves into two groups. In the first group there is the finding and selection of specimens which are not only perfect in themselves but which shall show as many of the desired characteristics as possible from one point of view. Then follows care in transportation and in suitably supporting the specimen so that its essential details—for instance, flower and a leaf—shall lie reasonably in a plane for easy focussing. This part of the work often calls for the greatest ingenuity.

The second group of problems includes the actual operations of photography. Lighting the subject to show up detail and textures, and precision in aiming the camera and focussing must often be decided and achieved very quickly, for small blooms will open even wider under strong light during the operations. Technically, it often becomes a running fight between good photographic craftsmanship, with satisfactory definition, and movement of the subject during the proceedings.

See Flower Photography; Photo-micrography; Plant Photography.

BOTTLES. Bottles form indispensable items in the equipment of every photographer, and the following notes will prove of service to photographic workers.

Whilst many amateurs may, of necessity, have to bring into use domestic bottles for photographic purposes, it is better, when equipping a dark-room, to obtain standard-sized bottles (which may be procured from any laboratory suppliers), corked or glass-stoppered, in sizes ranging from one ounce to thirty-two ounces capacity. For the average worker, four-, six-, and eight-ounce bottles are the most suitable.

If any bottles contain poisonous chemicals they should be clearly labelled, should always be kept well stoppered or corked in special bottles and should be given a special place on the shelf. Bottles containing scheduled poisons, as, for instance, mercuric chloride and potassium cyanide, are legally required to be kept under lock and key.

For containing the fixing solution, nothing is better than a "Winchester quart" bottle, for it holds a large volume of liquid and obviates the too frequent making up of the hypo solution. It is an advantage to store two solution developers in bottles of different size or shape, so that they may be readily identified in the darkroom.

While ordinary well-fitting corks serve for most purposes, strong acid solutions and powerful alkalis must be kept in glass-stoppered bottles, otherwise the contents of the bottles will quickly destroy the corks. "Rubber corks" are useful on account of their being absolutely non-porous and therefore not admitting air into the bottle, but they are more expensive than ordinary corks, are not particularly stable to some chemical fumes and are all soluble in some liquids.

Glass stoppers, particularly when the bottles contain alkaline solutions, sometimes tend to stick in the bottle neck. At times the stopper may be loosened by gently tapping the bottle neck on a hard surface. If this plan fails, the bottle neck may be cautiously heated over a flame, or, alternatively, the entire bottle may be immersed up to the neck in warm (not hot) water. The consequent expansion of the glass will usually suffice to loosen the stopper. If, however, the bottle contains a very volatile liquid, such as ether, the heating should be very carefully carried out for fear of too great a pressure being generated by the vaporization of the liquid within the bottle.

Negative varnishes are best kept in "capped" bottles, which are provided with a glass cap that fits over the outer sides of the neck. In this manner, such liquids are maintained perfectly free from contamination by pieces of cork.

Some photographic solutions are measured out in drops. Such liquids are best kept in specially constructed "dropping-bottles," from which they may be accurately dispensed. In the absence of a dropping-bottle, drops may be obtained by pouring the liquid carefully down a glass rod.

For containing substances which are affected by light, as, for example, silver nitrate, organic developers and so forth, amber-coloured bottles should be used, the glass of these bottles filtering out the harmful active rays of the light.

All bottles should be kept clearly labelled, and, in the case of bottles containing compounded solutions such as developers, it is an advantage to have the formula written on the label in order to avoid searching in reference books when the contents of the bottle need renewing. Paper labels invariably drop off when the bottle is stored in a moist atmosphere, but this trouble can be overcome by painting a thin layer of molten candle wax over the label, by brushing it over with shellac varnish or, best of all, by giving the label and its edges a thin coating of celluloid varnish, prepared by dissolving scrap celluloid in amyl acetate.

When bottling very deliquescent salts, such as sodium sulphide or ammonium sulphocyanide, the cork should be painted over with a layer of wax. This will prevent the salt from absorbing atmospheric moisture and so running to water.

Difficulty is often experienced in pouring small quantities of liquids from wide-necked bottles. The method illustrated in Fig. 1 will overcome this trouble. Insert through the cork two bent glass tubes. When the bottle is tilted the liquid will flow gently out of one of the tubes, but by placing a finger over the end of the other tube the flow will immediately be arrested.

It is not usually advisable to pour a solution back into a bottle after it has been used. If, however, this is required to be effected, and no funnel is available, insert a glass rod into the bottle, hold it upright, as in Fig. 2, and pour the liquid down the rod.

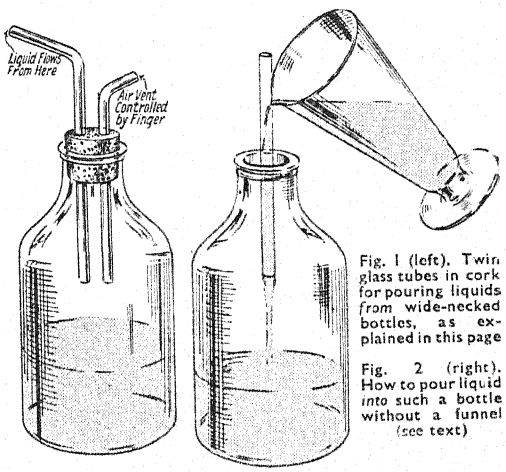


Fig. 1 (left). Twin glass tubes in cork for pouring liquids *from* wide-necked bottles, as explained in this page

Fig. 2 (right). How to pour liquid *into* such a bottle without a funnel (see text)

In pouring liquids from bottles, always hold the bottle so that the label is uppermost. This will prevent the liquid from running down that side of the bottle and soiling the label.—*J. F. STIRLING, M.Sc., F.I.C.*

BOX CAMERA: WHAT CAN BE DONE WITH IT

Although the simple box camera cannot compare with other more elaborate types in all-round efficiency, it is possible to secure extremely satisfactory and even brilliant pictures with it provided its limitations are understood. The box camera is essentially for the beginner, and this article gives valuable advice and information on the use and scope of the type

See also Beginners : Hints and Tips; Camera

Most amateur photographers start with a box camera, since it is simple, robust and cheap. Moreover, it is nearly automatic in action, while the simple form and small aperture of the type of lens employed obviate the difficulties in focussing likely to be experienced by the novice in handling more ambitious apparatus. The box camera has only those movements which are absolutely essential, and is fool-proof.

Obviously it has its limitations. The lens cannot be of high optical quality. Such a camera will be incapable of high-speed work, since the largest stop is not likely to be more then *f*7.7 and more probably *f*11. Moreover, even taking into account the rapidity of modern film, reasonably good light is required for satisfactory results.

Most box form cameras are equipped with some device for taking portraits at a distance of a few feet, either by the addition of a supplementary lens or by an arrangement for pulling out the lens a little way.

As regards manipulation, the book of instructions provided with the camera should be carefully read, and it is as well to devote some time to practising with an unloaded camera until the manipulations are mastered.

The following pictorial instructions with regard to loading the camera, will make

LOADING A BOX FILM CAMERA. The box form camera for roll films is probably the most popular type for the beginner to start with, and it certainly provides, within its somewhat narrow limitations, wonderful photographs for so simple a mechanism. The illustrations in this page show the first thing the owner of one of these cameras has to learn ; how to load it with a new roll of film

A series by courtesy of 'The Amateur Photographer'

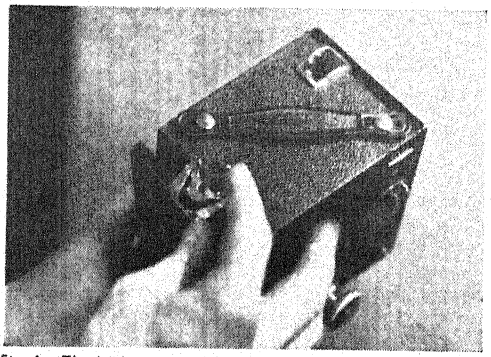


Fig. 1. The back is opened by freeing the clip or other similar device, as shown in picture above

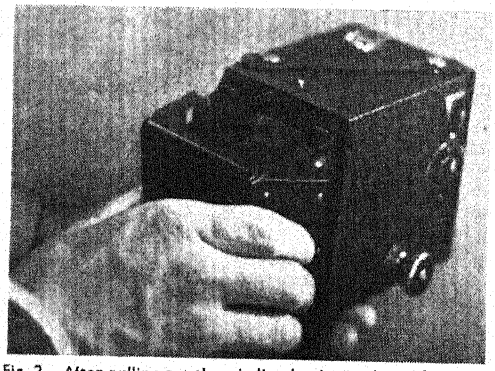


Fig. 2. After pulling out the winding knob to release the inner framework, draw out the latter, as above



Fig. 3. The spool, with seal unbroken (above), is placed in the side from which the old spool has been removed



Fig. 4. Breaking the seal, next unwind the first few inches of film, inserting the pointed end in the slit in the empty spool, which is placed in the other side of the framework (see picture above)

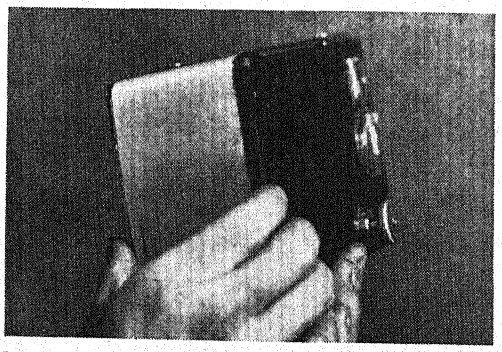


Fig. 5. Replace framework in camera (above), engaging one end of the empty spool with the winder by pressing latter in

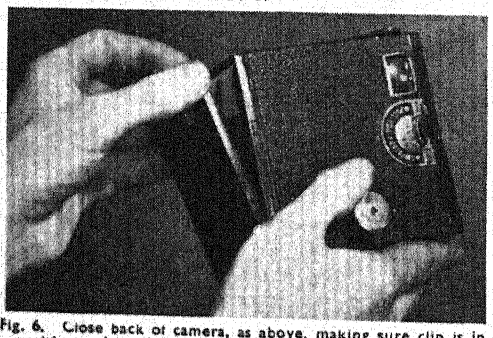


Fig. 6. Close back of camera, as above, making sure clip is in position and winding knob is properly engaged with spool

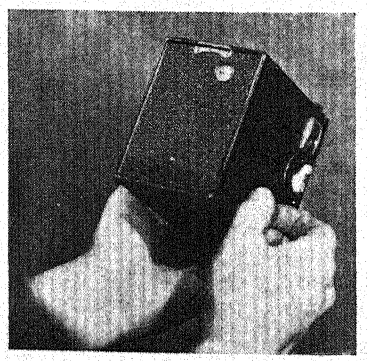


Fig. 7. Wind up film (right) until number 1 appears in red window at back of camera. Camera is now ready for first exposure



Fig. 8. For a time exposure, no matter how brief, the camera must be rested on a firm support

that plain even to those who have never handled a camera before. The essential point is to see that after the end of the paper support is passed through the slit of the empty reel, it draws straight, otherwise the film will jam.

Time Exposures. Time exposures are of much greater importance to the owner of a box camera, because they allow him to go on making pictures when the light is really only strong enough for snapshots with a faster lens than his. The fastest time exposure which can be made by just "ticking-over" the shutter is about six times as long as an "instantaneous" one, and so produces many a fully exposed film in the kind of light when a snap would be out of the question.

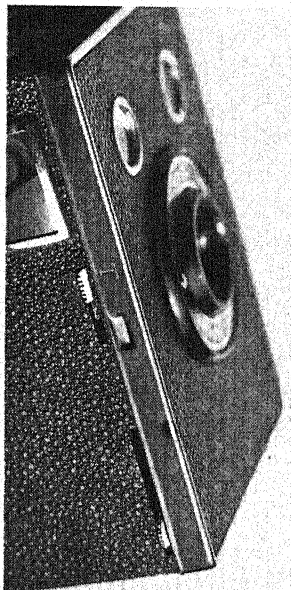


Fig. 9. In the Brownie camera the shutter is set to "Time" by moving the lever to "T"

It is quite easy to make a time exposure. The one essential is to have a firm place to rest the camera on. Pressure with a finger and thumb, as in Fig. 8, is then quite enough to prevent the chance of shaking the camera.

Each camera has its own special device which must be first brought into play to enable one to give a time exposure. The "Brownie," illustrated in Fig. 9, has a little lever to be slid from the lower notch in the slot to the upper one marked "T." Then pressing the exposing lever opens the shutter. The shutter will

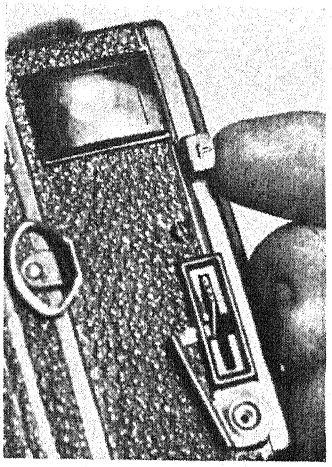


Fig. 10. In the Box Tengor the catch shown is pulled out for time exposures

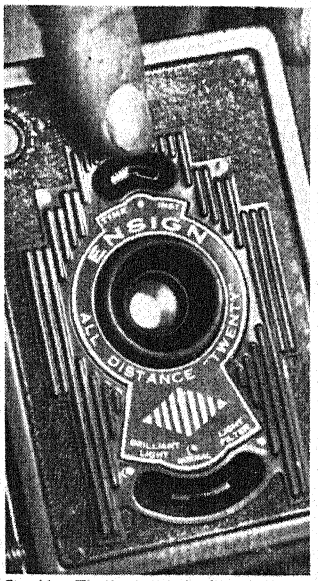


Fig. 11. The lever on the front panel is used to set the shutter of this Ensign camera to "Time"

stay open until the exposing lever is moved back again to where it was. These two movements can be combined in one swift to-and-fro action for outdoor pictures; while for indoor subjects a longer interval should elapse before closing the shutter.

In the Tengor camera of Fig. 10 the shutter is prepared for time exposures by pulling out the catch marked "T." The exposing action is also different; the exposing lever is pressed over to open the shutter, which will then close by itself as soon as the pressure is released. So that for all time exposures, except the briefest, the exposing lever must be held down by a finger. This lever is provided with a safety-catch to prevent the exposing lever from being accidentally pressed, but this catch should not be used to keep the shutter open for time exposures.

Before attempting to make a time exposure with the Ensign box camera, shown in Fig. 11, set the lever on the front panel, which is clearly marked for this adjustment. In this camera, also, the closing of the shutter occurs automatically.

But it should be the universal rule to put the shutter adjustment back to "Instantaneous" as soon as one has finished taking time exposures.

For the use of newcomers to photography we append a list of some of the most popular box cameras giving particulars of the size of picture obtainable with each.

BOX FILM CAMERAS OF POPULAR TYPES

AGFA BOX 41
For Pictures 2½×1⅝ in.

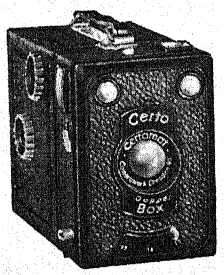
Box camera fitted with single lens in T. and I. shutter. View-finders for upright and horizontal pictures. Dimensions 4×3½×2⅝ in.; weight 11½ oz. Price 10s. 6d. Messrs. Agfa Photo, Ltd.



Agfa Box 41

THE CERTO DOUBLE-BOX
For pictures 2½×3¼ in. and 4.5×6 cm.

This camera makes either 8 exposures size 3¼×2¼ or 16 half-size pictures on a standard film. The mask for the smaller size can be brought into operation at any moment from the outside of the camera by turning a knob. It is covered with finely grained leather and is equipped with a Certomat doublet lens working at *f*11. Additional stops, *f*16 and *f*22, are fitted and there is a built-in supplementary lens for taking close-up pictures over the range 3 to 9 feet. The shutter gives Instantaneous exposures, and also short or long Time exposures. The camera has two large brilliant view-finders, and is equipped with two tripod bushes, and a stout carrying handle. Dimensions, 5-1/10th × 4-1/10th ×2-9/10ths in. Price £1 2s. 6d. Actina, Ltd.



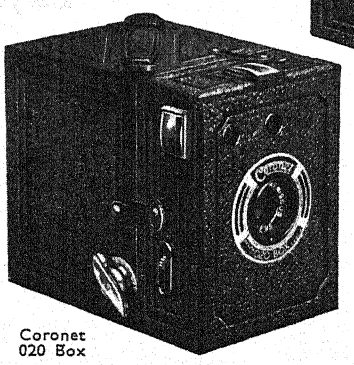
Certo Double-Box

THE CORONET "BOY" BOX CAMERA
For pictures 3¼×2¼ in.

Box camera, fitted 4⅛-in. *f*14 single lens in everset snapshot shutter. Two ground-glass finders. Dimensions, 4½×4×3 in.; weight, 14 oz. Price 3s. 11d. Coronet Camera Co.

THE CORONET 020 BOX CAMERA
For pictures 3¼×2¼ in.

Box camera, fitted 4-in. Meniscus lens, working at *f*14. Time and Instantaneous shutter. Extra large brilliant finders. Dimensions, 4½×4×3¼ in.; weight, 18 oz. Price 5s. 6d. Coronet Camera Co.



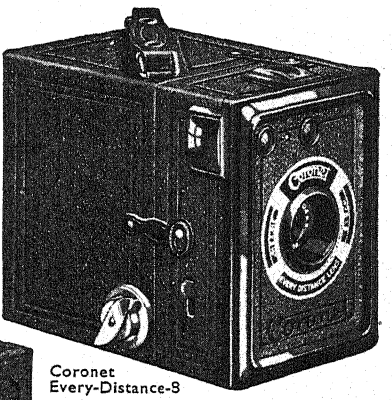
Coronet 020 Box

THE CORONET PORTRAIT BOX CAMERA
For pictures 3¼×2¼ in.

Box camera, fitted 4-in. *f*14 Meniscus lens in Time and Instantaneous shutter. Portrait lens for close-ups to 3 feet incorporated. Has two large brilliant finders. Dimensions, 4½×4×3 in.; weight, 15¾ oz. Price 7s. 6d. Coronet Camera Co.



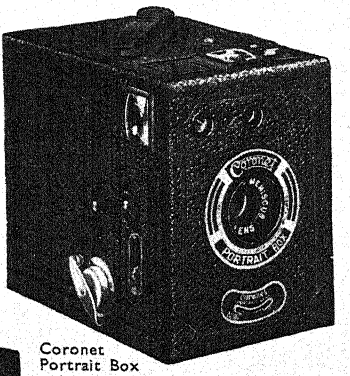
Coronet "Boy"



Coronet Every-Distance-8

THE CORONET EVERY-DISTANCE-8 BOX CAMERA
For pictures 3¼×2¼ in.

Box camera fitted 4-in. *f*14. Every-Distance lens, allowing close-ups or views to be taken without additional attachments. Time and Instantaneous shutter. Large brilliant finders. Dimensions, 4½×4×3 in.; weight, 21 oz. Price 8s. 6d. Coronet Camera Co.

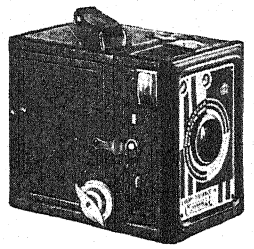


Coronet Portrait Box

THE CORONET EVERY-DISTANCE-16 BOX CAMERA
For pictures 3¼×2¼ in. or 4.5×6 cm.

This camera, which makes either 8 exposures 3¼×2¼ in. or 16 half-size exposures on a 3¼×2¼ spool, has a built-in colour filter which is brought into operation by pulling out a slide. It is fitted with a one-way Time and Instantaneous

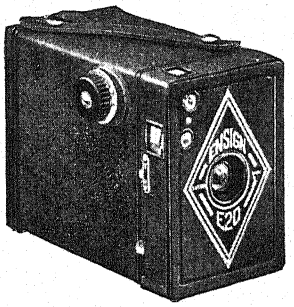
shutter, and has an Every-Distance lens working at *f*11. Fitted with two large brilliant view-finders and provided with a leather carrying handle it costs 10s. 6d. Dimensions, 4½ × 3-9/10ths × 2-9/10ths in.; weight, 21¼ oz. Price 10s. 6d. Coronet Camera Co.



Coronet Every-Distance–16

THE ENSIGN E.20 BOX CAMERA
For pictures 3¼ × 2¼ in. or 4.5 × 6 cm.

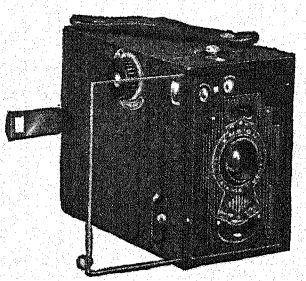
This camera makes 8 exposures size 3¼ × 2¼, or by fitting a mask into position can be adapted for 16 half-size exposures on the same film. A noteworthy point is that when out of use the film-mask is housed within the camera. The lens is the Ensign All-Distance, and takes pictures at any distance from 6 feet upwards without using a portrait attachment. The shutter gives Time or Instantaneous exposures, and the release is coupled to the winding knob so that a second exposure cannot be made until the film has been wound on. The camera has two brilliant view-finders and a leather carrying-handle, and is finished in black ripple enamel. Dimensions, 4¾ × 4¼ × 3 in.; weight, 23 oz. Price 8s. 6d. Ensign, Ltd.



Ensign E.20

ENSIGN ALL-DISTANCE-20 No. 2
For pictures 2¼ × 3¼ in.

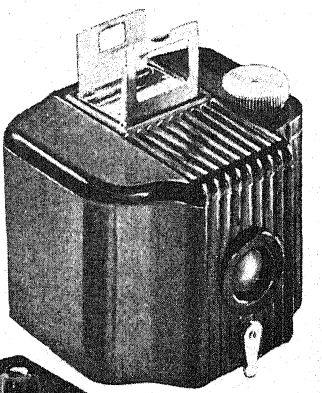
Box camera, fitted 4-in. *f*11 All-Distance lens, focussing from 3 feet to infinity, mounted in Time and Instantaneous shutter which operates one way only and has the lever protected from inadvertent release. Two brilliant finders and wire frame direct-vision finder with disappearing back and front sights. A yellow filter has been built into the body of the camera for use when desired. Dimensions, 4¾ × 4¼ × 3 in.; weight, 23 oz. Price 15s. Ensign, Ltd.



Ensign All-Distance–20 No. 2

THE BABY BROWNIE
For pictures 6.5 × 4 cm.

This camera, the body of which is of moulded material in a modern design, is fitted with a single lens in a snapshot shutter, and gives pictures sharp at all distances greater than 5 feet. The view-finder is of the metal-frame type, folding down into a recess on the top of the camera. Price 5s. Kodak, Ltd.



The Baby Brownie (Kodak, Ltd.)

THE POPULAR BROWNIE
For pictures 2¼ × 3¼ in.

This camera is fitted with a Kodak single lens fitted in Time and Instantaneous shutter. It has two ground-glass view-finders, and takes 6-20 film. Dimensions, 4½ × 4¼ × 3 in.; weight, 12 oz. Price 5s. 6d. Kodak, Ltd.



The Popular Brownie (Kodak, Ltd.)

SIX-20 BROWNIE JUNIOR
For pictures 3¼ × 2¼ in.

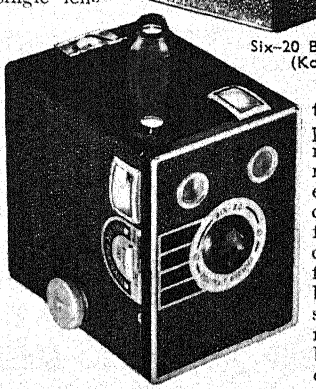
A box camera, fitted with single lens and Time and Instantaneous shutter. All-metal body with hinged back. Two ground-glass finders. Takes 6-20 spool. Dimensions, 4¼ × 4 × 3 in.; weight, 14 oz. Price 8s. 6d. Kodak, Ltd.

SIX-20 BROWNIE JUNIOR (Super Model)

Specification as Six-20 Brownie Junior, except that brilliant finders are fitted, and the finish of the camera is superior. Weight, 16 oz. Price 12s. 6d. Kodak, Ltd.

THE SIX-20 PORTRAIT BROWNIE
For pictures 3¼ × 2¼ in.

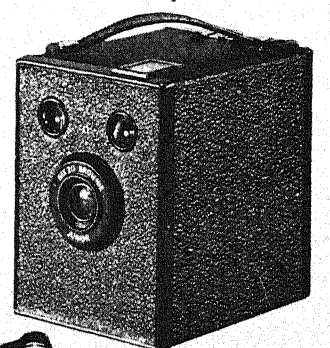
A box-form camera fitted with single lens and Time and Instantaneous shutter. A portrait attachment which can be brought into action by pulling a slide built into the camera. Two large brilliant finders are fitted, and the camera takes the 6-20 spool. Dimensions, 4 × 4 × 3 in.; weight, 18 oz. Price 17s. 6d. Kodak, Ltd.



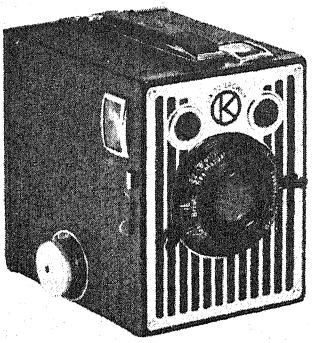
Six-20 Portrait Brownie (Kodak, Ltd.)

SIX-20 BROWNIE
For pictures 3¼ × 2¼ in.

Fitted with Kodak lenses working at *f*11 and a shutter for Snapshots and Time exposures. To facilitate the use of lens stops the lens mount bears the indications "Landscapes," "Groups" and "Portraits," and the lever which opens and closes the diaphragm is moved beneath whichever class is chosen. The front of the camera is finished in brilliant stainless metal with black enamelled striped design. Two large brilliant



Six-20 Brownie Junior (Kodak, Ltd.)



Six-20 Brownie (Kodak, Ltd.)

finders are fitted and the camera takes the 6-20 spool. The front is finished in brilliant stainless metal with black enamelled stripes, and the price is 21/-. Kodak, Ltd.

ZEISS IKON BABY BOX TENGOR
For pictures 4×3 cm.

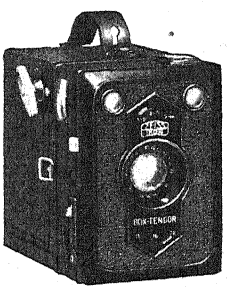
This camera makes 16 exposures on an ordinary 8-exposure spool of V.P. size film. It is fitted with a Frontar lens working at *f*11, and gives sharp pictures of all objects not less than 6 feet from the camera. The shutter gives Time and Instantaneous exposures, and has a socket for wire release, and there is a safety catch preventing it from being released unintentionally. Two tripod bushes are fitted. The finder is of the direct-vision wire-frame type, and the camera, which measures only 2×2⅝×3-3/16ths in., costs 18s. 6d. Zeiss Ikon, Ltd.

ZEISS IKON BOX TENGOR No. 54
For pictures 4.5×6 cm.

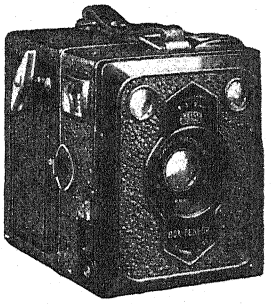
This camera makes 16 exposures on a 3¼×2¼ film. Its specification closely follows that of the Baby Box Tengor, but there is built into it a supplementary lens focussing over a range 3 to 10 feet. With this lens out of use objects at 9 feet or over from the camera are sharp. Adjustable stops are fitted to this model, *f*22 being available as well as *f*11. A safety catch prevents unintentional release of the shutter. The frame finder is replaced by two large brilliant finders. The camera, covered with neat grained leatherette, with leather handle, costs 22s. 6d. Dimensions, 2⅞×3-5/16ths×3⅝ in. Zeiss Ikon, Ltd.

ZEISS IKON BOX TENGOR No. 54/2
For pictures 3¼×2¼ in.

Box-form camera, fitted *f*11 Frontar lens in Time and Instantaneous shutter, with safety catch and socket for wire release. Adjustable stops, *f*11, *f*16, *f*22. Has two supplementary lenses built in for portraits and groups. Dimensions, 4½×4⅛×2⅞ in.; weight, 19 oz. Price £1 5s. Zeiss Ikon, Ltd.



Zeiss Ikon Box Tengor No. 54/2



Zeiss Ikon Box Tengor No. 54

ZEISS IKON BOX TENGOR No. 54/15

For pictures 4¼×2½ in.

Except for size this camera is identical in specification with the Box Tengor No. 54/2. The cost is 32/6. Zeiss Ikon, Ltd.

BRILLIANCY (in Negatives and Prints). Brilliancy is a quality which most photographers strive after, but is often confused with mere contrast.

The kind of negative which produces a brilliant print is not in itself of brilliant appearance. Beyond being free from fog, as denoted by transparent edges where screened in the camera, a negative should seldom possess brilliantly clear shadow detail, nor should its denser parts exhibit the least tendency towards opacity. On the other hand, a negative which consists entirely of a range of delicately transparent greys will only give a brilliant print with extreme care on contrasty paper.

If a photograph which has the greatest illusion of brilliance be closely analysed, it will be seen that the parts which are quite white or quite black are both very few and very small in area. Almost invariably such results are obtained from subjects which have no intense shadows yet are brilliantly lit, and the correctly exposed negatives of which have been developed to suit a printing-paper of normal grade.

Adventitious aids to brilliance, such as abnormal development of the negative or use of contrast paper, never produce quite the same illusion, and should be reserved for treatment of dull subjects. *See also* Developing; Exposure; Negative; Printing.

BROMIDE and BROMINE. Bromide s a compound of bromine with other elements except chlorine, oxygen and fluorine. Silver bromide (AgBr) is extremely sensitive to light, and so is largely employed in the manufacture of photographic plates and papers.

The alkali bromides, such as potassium bromide and ammonium bromide, are used in developing solutions as restrainers, to prevent the too energetic action of the developer upon the exposed emulsion.

Bromine is a non-metallic element which is not found in a free state in nature, but combined with magnesium, potassium or sodium. It is one of the two liquid elements, the other being mercury.

Bromine is extracted from sea water, and also from certain salt deposits, such as those at Stassfurt in Southern Saxony.

BROMIDE PAPERS & THEIR CHARACTERISTICS

F. J. Mortimer, Hon. F.R.P.S.

Editor of 'The Amateur Photographer' and 'Photograms of the Year'

The development of bromide printing has had a major influence in photography today, and without this process the results that are now common in all branches of photographic art could never be attained. This article explains the characteristics of the latest types of bromide paper, and gives advice on the selection and handling of the various grades for specific work. Useful formulae are also included

See also Bromide Printing ; Carbon Process ; Developing ; Enlarging

THE photographic print is the achievement for which the camera, lens, film, exposure and negative are merely the means of attainment. It is necessary, however, if the achievement is to be perfect, that the printing method employed should be capable of doing justice to the other processes preceding it that register the image in the first place. There is no point in producing a perfect negative, to which the skill of the modern optician and chemist have been devoted, if the printing process fails to render finally all the qualities that have been so painstakingly obtained. To do so would be analogous to the use of an imperfect wireless set to receive a very elaborately produced broadcast.

Of all the printing methods available at the present time, the one most varied in its characteristics, and probably most capable of giving perfect results in many different circumstances, is the bromide process.

Immense Variety of Grades

Recognizing that photographic negatives made under a great variety of conditions differ in their densities, contrasts and tonal qualities, the makers of bromide paper have developed their technique enormously in recent years, and now offer a product that is not only as near perfection as mechanical means can contrive, but is also produced in such a diversity of grades that with it practically any type of negative can be adequately translated into a black and white positive print without loss of quality.

"Bromide" is a development paper. No image is visible after exposure. This has to be developed with suitable chemicals. A specially selected, chemically pure paper is used as a base, which is first treated with a preparation of barium sulphate and then coated with a sensitive bromide of silver gelatine emulsion, similar in some respects to that used for coating plates and films, but considerably slower. Its slow speed permits it to be manipulated with safety in yellow or orange light.

The characteristics of bromide papers are such that they offer considerable advantages to the photographer over every other printing process. Outstanding is the independence of daylight in its use. This fact has placed it on a pinnacle of popularity that the older daylight printing processes failed to reach, particularly in this country, where daylight is such a variable quantity.

Advantages and Qualities

Artificial light, which can be used in bromide printing and enlarging, can be made a constant factor, but even this would not be sufficient to ensure success if the process did not include a number of other definite advantages. Among these we may mention simplicity in use, range of colours obtainable, adaptability to negatives of widely different quality and characteristics, economy in use and, above all, fine quality in the final print.

It is obtainable for the amateur in cut sheets of the usual photographic sizes. These are supplied in black paper envelopes and securely wrapped against accidental light. The packets are opened in the darkroom, and the paper exposed in a printing frame under the negative for contact work, or attached to an easel for use with an enlarger. The latter phase of bromide printing is dealt with under Enlarging.

The great variety of grades referred to above is a notable asset to the user of bromide papers. These grades have been given various distinctive names, such as "Contrasty," "Normal," "Soft," etc., which indicate that prints made on them will give

respectively results that are very black and white and hard in contrast, prints with a full range of tone, or at the other end of the scale with very even and low tonal quality.

These characteristics, however, are intended to be applied in compensating tonal differences in the negatives themselves. For instance, a very flat or thin and over-exposed negative can be made to render a print that will have a much steeper degree of contrast, and be much harsher in tone, by the use of a "hard" or "contrasty" paper, and again a hard-contrast negative will give a soft, full-toned print by the employment of a soft gradation paper, and so on; in fact, the various grades of bromide paper obtainable can be chosen to suit practically any kind of negative, the "normal" variety being so made to get the best results from what is regarded as a "normal," good negative; one that has been correctly exposed and correctly developed.

Surface Varieties

In addition to these different grades, bromide papers are also produced in a great variety of "surfaces." These range from glossy, with a highly glazed surface, through semi-matt, or slightly glazed surface, matt, rough, to very rough textures. Each of these surfaces presents an opportunity to make the most of the pictures produced on it, according to the result required. Glossy prints, for instance, are made when the finest detail of the negative is required, particularly for press purposes or reproduction work, whereas the rougher surfaces are best suited for exhibition or pictorial work on a large scale.

One well-known maker lists no fewer than 40 varieties of bromide paper, and another 60, each of these with still further differences of surface textures, and of cream and white paper base, and in single and double weight, so that every possible type of negative, both of amateur and professional production, is provided for. Of course, this does not take into account other varieties of printing processes akin to bromide, such as "Chlorobromide," "Gaslight papers," etc., which are also development papers. These are dealt with separately elsewhere in this Encyclopedia.

In most of the older textbooks on photography, when every process was still in the experimental stage and capable of further improvements at any moment, more space was always devoted to instructions on "How to make sensitive material," rather than on how to use it. Many workers of the old school made their own plates and papers and annotated the pages of their textbooks with the results of their own experiments.

Today the case is very different. In the case of bromide paper the whole process of manufacture is in the hands of the commercial firms, who have specialized in the matter, and in their completely equipped laboratories and factories trained chemists and emulsion makers concentrate on producing sensitive material as perfect as modern science can make it. Made in this way, in bulk, it can be sold at a price with which no amateur could hope to compete.

Because he has not this knowledge, however, he is no less capable of producing fine prints and successful pictures, but he is quite content to leave the manufacture of bromide paper to the commercial specialist.

As a result, all that the modern photographer has to do is to concentrate on the best methods of using the very perfect products that he can buy ready for use.

The Manufacturing Process

At the same time it may be of interest to many readers to indicate briefly the formulae employed in making bromide paper, although to succeed with its manufacture very much greater detail would be required, and special appliances. The question of emulsion making generally is dealt with under Emulsion.

A formula given by Dr. Eder is the following:

Ammonium bromide	20 parts
Gelatine	50–80 parts
Distilled water	400 parts

Allow the gelatine to soak in the water for 12 hours, then dissolve at a temperature of 50–60° C., and add the bromide; then in the dark-room add gradually, with constant and violent shaking, the following solution heated to 50–60° C.:

Silver nitrate	30 parts
Distilled water	400 parts

Allow the solutions to stand from half to one hour, and then pour out into a flat dish to set. When thoroughly set break up into small pieces, and wash in the usual manner.

E. J. Wall gives an alternative formula as typical of that employed commercially :

Potassium bromide	400 gms.
Citric acid	400 gms.
Gelatine	150 gms.
Water	1,800 ccm.

Soak the gelatine in the solution of the salts and melt at about 50° C. (122° F.), then cool to 30° C. (86° F.) and add :

Silver nitrate	500 gms.
Water	3,750 ccm.
Ammonia	q.s.

Temperature of mixing 30° C. (86° F.). As soon as mixed, pour into :

Gelatine	150 gms.
Water	600 ccm.

Raise to 50° C. (122° F.) and, as soon as the gelatine has melted, set. After washing, melt to 40° C. (104° F.) and add :

Gelatine	454 gms.
Water	1,600 ccm.

previously soaked and melted. Then add :

Alcohol	568 ccm.
Chrome alum, 10% soln.	30 ccm.

The total bulk should be 11,400 gms.

In some cases a very small proportion of iodide is used, about 0·5 to 1·0 per cent. The quantity of gelatine naturally varies with the surface desired, whether glossy, half-matt, etc. In the above formula it is approximately 1 : 15. For obtaining a real matt surface, various additions have been made, such as tripoli, kieselguhr (infusorial earth) and rice starch. In order to obtain half-matt surfaces, the starch should be boiled in water until a transparent paste is formed, cooled and added to the emulsion before filtering.

The bromide paper is susceptible to careless handling, and should be opened only in a yellow dark room light.

In this light it is difficult at first to decide which is the sensitive and which the insensitive side of the paper, unless they are of the glossy or very rough grades, when the difference is at once apparent. The sensitive side, however, is generally indicated by the edges of the paper curling inwards. If any doubt arises the extreme corner of a sheet can be slightly moistened with the finger or tip of the tongue, when the gelatine side is ascertained by its slight stickiness. Touching the surface, particularly with damp fingers, should be avoided, as this may cause marks.

If the worker is using bromide paper in a large way it is cheaper to purchase the material in rolls, cutting off the necessary amount as required. These are generally sold in 10-feet and 25-feet rolls, and in widths from 12 inches to 40 inches wide. If smaller sizes are used in quantity it is obtainable in gross boxes, but is usually sold in packets containing 12 sheets in the smaller and six sheets in the larger sizes.

BROMIDE PRINTING: THE BEST METHODS

F. J. Mortimer, Hon. F.R.P.S.

Editor of 'The Amateur Photographer' and 'Photograms of the Year'

The most widely used method of producing photographs today is undoubtedly by making contact prints or enlargements on bromide paper. The process is a comparatively easy one, but the production of a satisfactory bromide print depends, apart from the use of a suitable negative, upon the proper exposure and development of the printing paper; and in the following article the method of procedure is carefully explained

See also Carbro Process ; Developers ; Gas-Light Paper ; Enlarging ; Toning

MAKING prints on bromide paper is a comparatively easy process and is probably the most popular method of producing photographs in use today. The prints may be amateur snapshots, made by contact on glossy paper, or they may be big exhibition pictures on rough paper, or, again, they may be press prints made in the rush of modern journalism, but the essentials are the same ; the paper has first to be exposed to the light passing through a negative for a definite time and developed. It is then fixed, washed and dried. The whole process occupies a matter of minutes, can be conducted entirely in artificial light, and is completely under the control of the worker.

To describe in detail the making of a contact print on bromide paper may prove useful to those readers who hitherto have never attempted it, and will, in fact, outline the process also for the production of bigger prints by enlargement.

The chosen negative is placed in a printing frame of the correct size. If it is a film negative a piece of plain, clean glass should be put into the frame first to support it.

This is done in the dark room—illuminated by yellow or orange light only. The packet of bromide paper is opened, a piece taken out and placed with the sensitive side in contact with the film side of the negative. The back of the printing frame is replaced, and the remainder of the packet of paper is wrapped up again to avoid accidental fogging.

The exposure is then made by holding the front of the frame towards a bright light for a certain number of seconds.

The light can be from any available source. Electric light is the best, as it can be readily switched on and off as required, but gas or even candle light might, with greatly increased exposure, be used. It is necessary, however, for the printing light to be constant in power, and the frame held or placed at a definite distance from it, if a number of prints are wanted of the same subject.

Basic Importance of Exposure

After exposure and before development the paper shows no visible image. It possesses, however, a "latent" image in the same manner as a plate or film; this latent image is made visible by development.

The character of the image that is developed depends on the length of exposure given; the greater the exposure the darker will be the image, and the tones of the negative are transmitted inversely to the print. The darkest parts of the negative retard the progress of light, and in those parts the print remains white, or nearly so. The clearest parts of the negative allow the light to pass, and these become the darkest in the print.

The factors that influence the production of the print are: (1) the colour and opacity of the negative; (2) the speed and character of the bromide paper; (3) the strength of the printing light; (4) the distance of the light from the negative and print; (5) the time of exposure; (6) the time of development.

The colour and opacity of the negative in particular will not only have a bearing on the exposure, but its contrast quality will affect the result. A negative developed with pyro, for instance, or Meritol, may have a distinctly yellow or brown tinge. In all other respects it may be perfect, but the colour will act as a retarding element in bromide printing. The amount of this can be ascertained only by trial. The same applies to the general opacity of the negative. If very fully exposed and well developed it will be much denser than if it has been under-exposed and under-developed, and the print will require a longer exposure.

Adjustable Factors

All the other factors are more or less under control and can be adjusted to suit the negative. The printing distance, for instance, should be regulated by the opacity of the negative. A very dense negative should be printed at comparatively close range to the light, say 12 inches, while a "thin" negative may be exposed with advantage at three feet distance from the same light. To allow sufficient time for manipulation, the exposure time should be not less than 10 seconds, while a suggested normal time is a minute. This can be arrived at by trial and adjusting the distance accordingly. The speed of the paper varies in different makes, but the beginner is advised to stick to one make until he is familiar with its peculiarities.

While the great varieties of different grades of bromide papers available permit the production of good prints from almost any kind of negative, there is no doubt that the best results are obtained with the "normal" paper, printed from a well-exposed and correctly developed negative. If with such a negative the bromide paper is given what is found to be the correct exposure the print can be developed out fully.

Exposure Tests

To secure the correct exposure the simplest and most economical method is by means of test strips. A test strip is a piece of the same paper exposed in sections for different times and then developed. One of the sections will show the best result, and this indicates the correct time to give the entire print. The method applies to both contact printing and enlarging.

It is more economical in the long run, when starting to use a new packet of twelve sheets of bromide paper, to cut up one of these sheets into eleven strips. This will allow one test piece for each of the remaining sheets.

The exposures for the test strips to be effective should be in geometrical progression,

such as 4, 8, 16, 32 seconds, so that each exposure is double the preceding one. After the strip is placed in the printing frame under the negative to include, say, the middle part of the subject, it is entirely exposed for the first of the settled times, say four seconds.

A quarter of the paper is then quickly covered with a piece of black card, and when eight seconds have elapsed another quarter is covered. Then after 16 seconds have passed the third section is covered and finally a total of 32 seconds is given. The series can, of course, be extended much more than this if necessary, and other factors, say of 3 or 5 seconds in geometrical progression, can be given. The result will define the section that will give the best exposure time for the whole print.





BROMIDE PRINTING TEST. The preparation of a test strip (as seen above) for ascertaining the correct exposure is explained in this page; here the left-hand portion has been exposed for the whole period, the other portions being successively uncovered. On left is the print in the tone chosen (the second from left in upper photo)

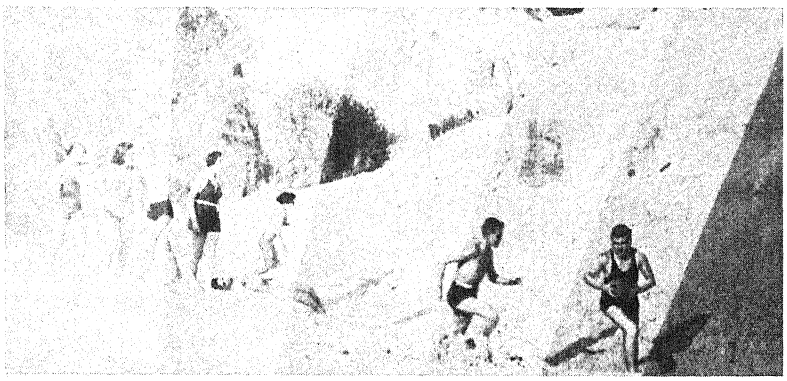
The same method is used in ascertaining the correct exposure when making enlargements on bromide paper. In this case the image is projected on to the strip, which is pinned on the enlarging easel, and is covered step by step with the piece of opaque card for a similar series of progressive exposures. To make sure that the right time for the entire picture is found the strip should always be adjusted so that it includes a part of the image of average density.

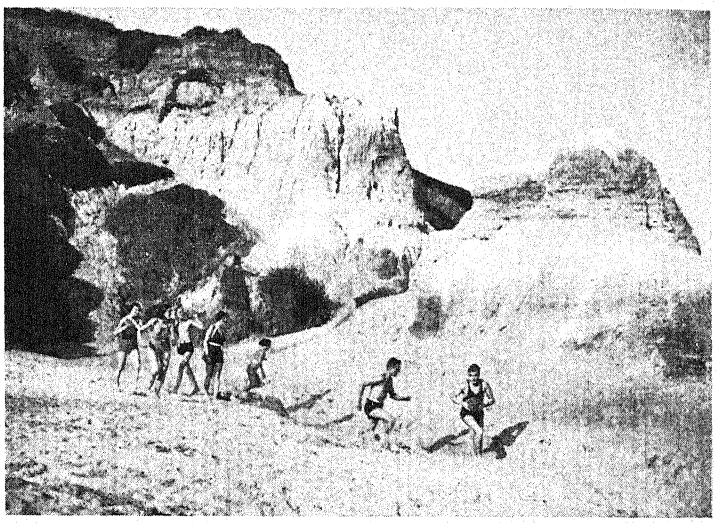
When the correct time has been ascertained by the test strip the exposure of the complete print can be made, and this will in its turn serve as a further guide for exposures with other negatives of similar colour and density.

An additional help to the production of the best result is to make use of the method of "time development." The exposed strip when placed in the developer is carefully watched, and the exact time noted that the first trace of the image takes to appear. This time is multiplied by a figure known as the Watkins factor (which varies with the developer, but is usually supplied by the makers), and the result gives the total time of development. The test strip should not be taken from the developer before this time has elapsed. If it turns too dark in every section too much exposure has been given, and another test strip giving shorter exposures must be tried. If at the end of the calculated time no section of the strip is sufficiently dark, too little exposure was given.

Do not try to examine test strips by the dark-room light, but fix them for a couple of minutes and examine them in a bright light; and always remember that the finished print will look a shade lighter than the wet test strip. Never guess exposures. Test strips take only a few minutes, and cost little compared with spoiled prints. Having found the correct time the print itself is exposed, and must be given the same period of development that was given to the test strip.

By using this method allowance is automatically made for all the variable conditions,





TEST STRIP FOR ENLARGING. As is explained in the text in the previous page, it is necessary to test a strip at different exposures (as seen above) when enlarging on bromide paper. On right is the print in the tone selected (the fourth from left in the test strip)
Photo, David Charles

including temperature, grade of paper, variations in compounding the developer, and exhaustion of developer. In connexion with this last point it cannot be too strongly emphasized that the best results can be obtained only by using fresh developer for every print.

While the foregoing suggestions for ascertaining the correct exposures have been given more particularly in regard to contact printing, the same general principles apply to the making of bromide enlargements. The actual procedure in making enlargements, however, is dealt with under the heading of "Enlarging," the present article being concerned more with the exposure and development of the bromide paper.

The general principles that apply to the development of bromide paper are similar in many respects to the development of negatives on exposed plates or films. In each case the emulsion is of silver bromide but whereas in the case of the film or plate it is of considerable speed, bromide paper is comparatively slow. The coating of the emulsion on the paper is also much thinner, and whereas the density image of a negative is judged by transmitted light, in bromide prints it is judged by reflected light.

If the developed image of the bromide print were transferred from its paper support to a sheet of glass and examined by transmitted light in the same way as a negative, it would be seen to be very thin and attenuated, with practically no density at all. In the same way, if the film of a fully exposed and developed negative were transferred to a paper backing and examined in the same way as a bromide print it would be apparently black all over. Apart from this difference in its basic form the development of a bromide print proceeds similarly to that of a negative.

The factors which influence development are: (1) the correctness of the exposure; (2) the composition and strength of the developer; (3) the temperature of the developer; and (4) the paper employed.

A number of developers are available for making bromide prints; the most important point is that they must be non-staining in character. It is for this reason that, unless for a special purpose, developers such as pyro, which are eminently suitable for negatives, are not advisable for paper prints, as they tend to stain the paper base.

The formulae that follows are specially adapted for the production of good bromide prints, giving a full black and white type of image; but as a general rule the best advice to be given, if a worker is compounding his own developer, is to follow implicitly the formulae advocated by the makers of the paper. These formulae are always included with each packet of paper that is sold.

The question of temperature of the developer for bromide prints is one that is worthy of more consideration than it usually receives. It will be found in particular that a developer containing hydroquinone, when used in cold weather or at a temperature that has been allowed to fall below 55° F. produces an entirely different character of image from that given by a similar developer at a temperature of 65° F., assuming that in both cases the solution has been freshly made up. The reason for this is that hydroquinone in any photographic developing solution becomes practically inert at a low temperature, and the developer of which it forms a part is only partially doing its work. This question of temperature does not apply so definitely to Amidol, which can be used successfully at temperatures where the M.Q. solution would give a very poor performance.

Amidol and M.Q.

Amidol, however, has two disadvantages that work against its universal use by the amateur, although it probably gives the finest black tones of any developer. One is that it has to be freshly made for each batch of prints developed, as it will not keep well for more than a day or two in solution, and secondly, its frequent use has a disastrous effect on the skin and finger-nails of the operator who dabbles in the solution. It produces a heavy brown stain, which is extremely difficult to remove.

Metol-hydroquinone developer (generally referred to as M.Q.) on the contrary can be made up either in two solutions or as a single solution developer, and if kept in fully stoppered bottles will retain its developing qualities for months, if not for years; it can be used two or three times in succession, although this is not advocated, and it is non-staining. Prints obtained with a properly balanced M.Q. developer can be made to give good rich black tones that are practically equal to those obtained with Amidol.

Metol-Hydroquinone Developer

Metol	18 grs.
Hydroquinone	70 grs.
Sodium sulphite (cryst.)	12 drachms
(*or* sodium sulphite anhydrous)	6 drachms
Sodium carbonate (cryst.)	12 drachms
(*or* sodium carbonate anhydrous)	265 grs.
10 per cent. soln. potassium bromide	60 minims
Water to	20 ozs.

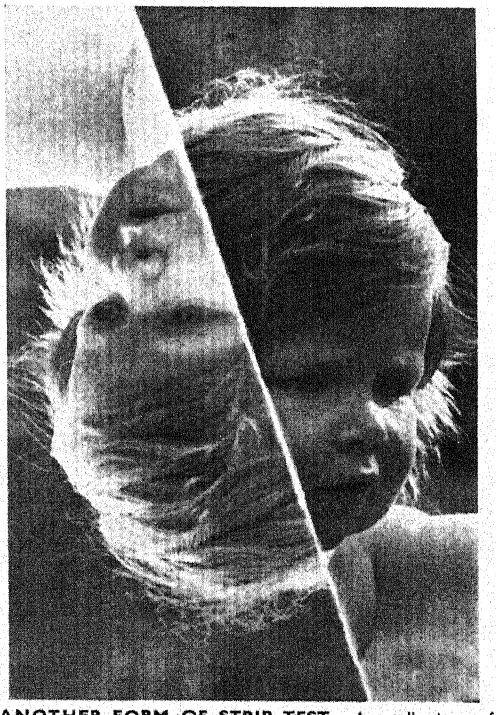
For use, dilute with an equal quantity of water.

The Watkins factor for this M.Q. developer for use with all bromide papers is 5.

An average bromide paper developed with this developer at 65° F. will exhibit a first appearance of the image in from 25 to 30 seconds, so that development will be complete in from 2 to 2½ minutes. The colour of the image yielded is a good neutral black.

Amidol Developer

Amidol	50 grs.
Sodium sulphite (cryst.)	1 oz.
(*or* sodium sulphite anhydrous)	½ oz.
10 per cent. soln. potassium bromide	20 minims
Water to	20 ozs.



ANOTHER FORM OF STRIP TEST. A small piece of paper is folded in two, emulsion side outwards. Each side is given a different exposure but on practically identical detail. This form is useful for portraits and other subjects having essentially important detail

Photo, David Charles

For use without dilution. This developer must be freshly made.

The Watkins factor with this developer for use with all bromide paper is 10.

An average bromide paper developed with this developer at 65° F. will exhibit a first appearance of the image in from 12 to 15 seconds, so that development will be completed in from 2 to 2½ minutes.

Other developers such as Azol, Rodinal, Rytol, Certinal, and various ready-made developers supplied by the makers, are also available for bromide prints. These are dealt with under " Developers."

Development of bromide prints is conducted in the dark-room by yellow light as the paper remains sensitive to white light until fixed. The exposed paper is taken from the printing frame—or, if an enlargement, from the enlarging apparatus—and laid face upwards in the developing dish.

If the prints are small ones, say, up to and including whole-plate size, the developer may be poured straight on to the paper without first wetting it in water. For larger prints it is best to allow the print to soak for a minute in clean water, swabbing over the surface with a tuft of cottonwool. The water is poured off and the print drained for a moment, and then the developer is poured over in one sweep and not allowed to descend on one spot only.

The preliminary wetting and swabbing is designed to prevent air bubbles forming on the surface, which, if occurring during development, will produce a number of small white spots in the print. With the large sizes it is a good plan also to swab the surface gently with a tuft of cottonwool as soon as the developer is applied, but with small prints, as a rule, this is not necessary provided the quantity of developer is not stinted and it is poured over the surface of the print quickly.

The developer being poured on, the dish is rocked gently, so as to keep the liquid moving over the surface of the print. If the exposure has been correct, the image will make its appearance in a few seconds, the actual time depending upon the strength of the developer and its temperature. Strong developer and high temperature speed up the process and *vice versa*.

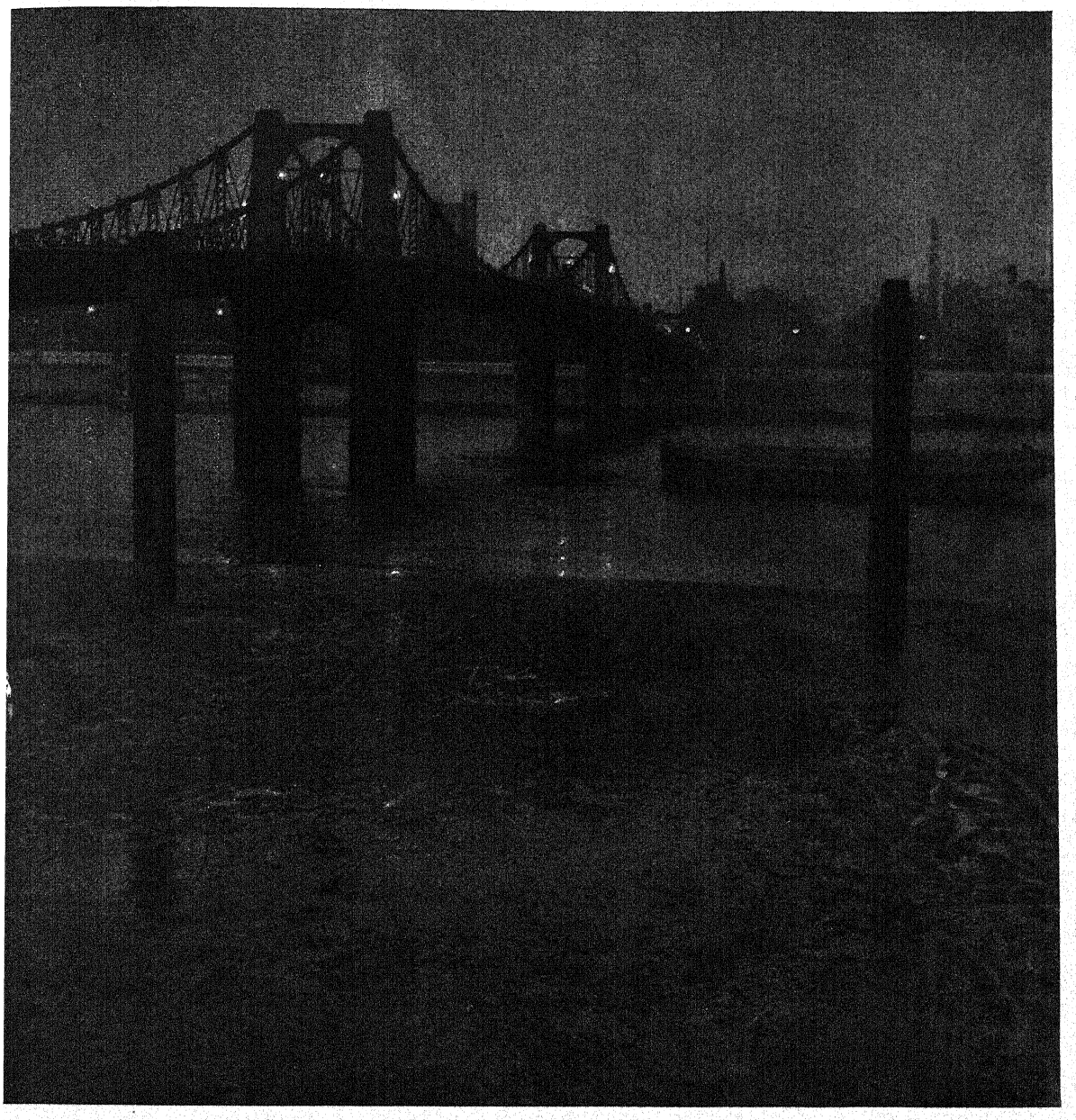
Over-exposure makes the image appear much quicker than it should do; with under-exposure the picture is very slow in appearing, and will lack strength. In these respects bromide paper behaves similarly to plates or films.

It is useless, however, to attempt to treat bromide paper in the same way as a negative; as, for example, adding accelerator to the developer to coax out detail from an under-exposed print. Such procedure will only result in harsh, crude prints, possibly with stained high-lights. The proper course is to make a second exposure, the duration of which may be gauged with approximate accuracy by the appearance and behaviour of the under-exposed print. On the other hand, over-exposure may to some extent be corrected, if it has not been unduly excessive, by diluting the developer with an equal



BROMIDE FOR BROMOIL. The photograph of old Lambeth Bridge which appears in the opposite page as a bromoil is seen above in its original bromide form. Note that reasonable contrasts and a full range of tones in the bromide provide the best original for the bromoil

Photo, F. J. Mortimer



OLD LAMBETH BRIDGE F. J. Mortimer, Hon. F.R.P.S.

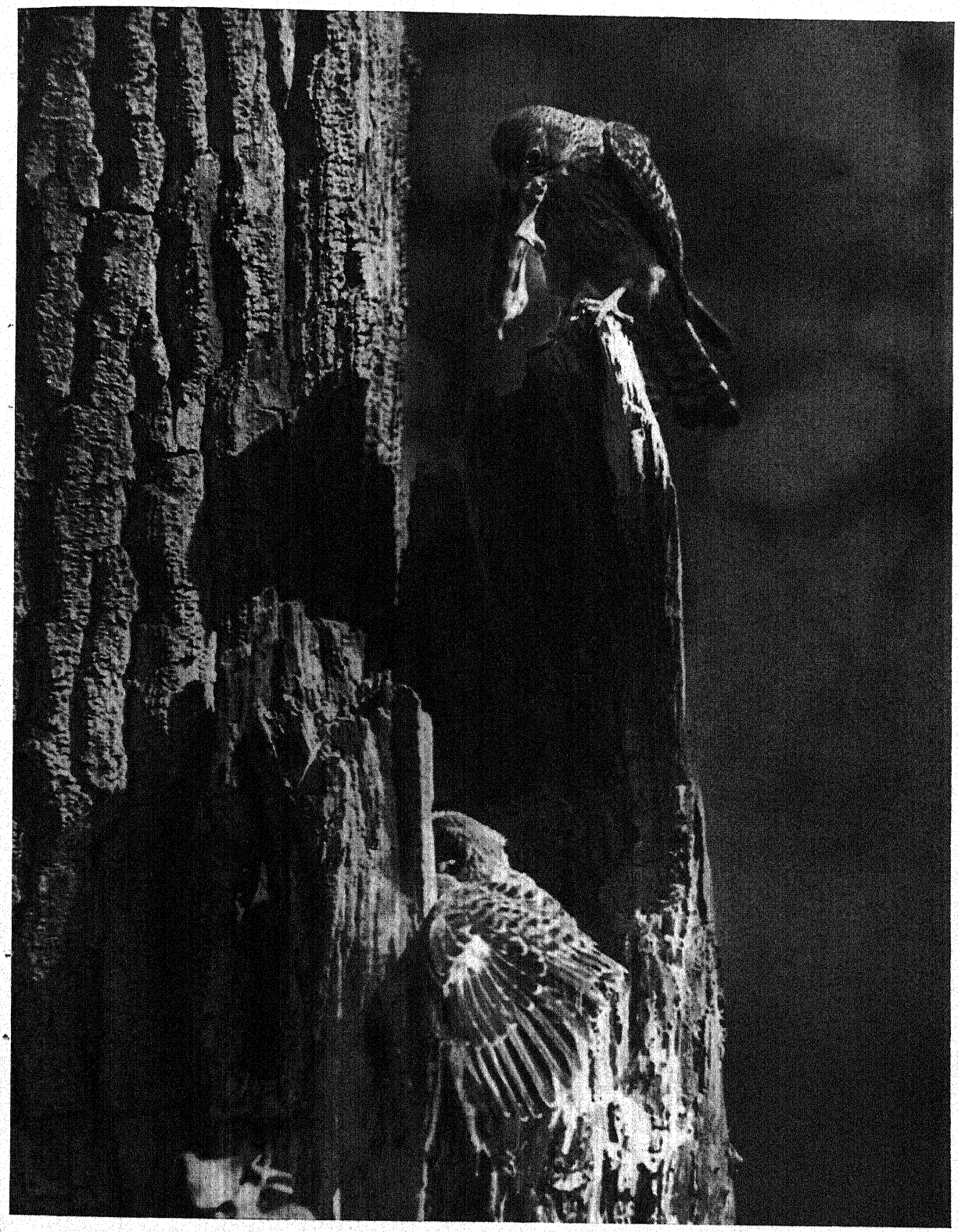
A bromoil print; compare with bromide print in opposite page, and see article on Bromoil (pp. 209–216)



NATURE'S DESIGN

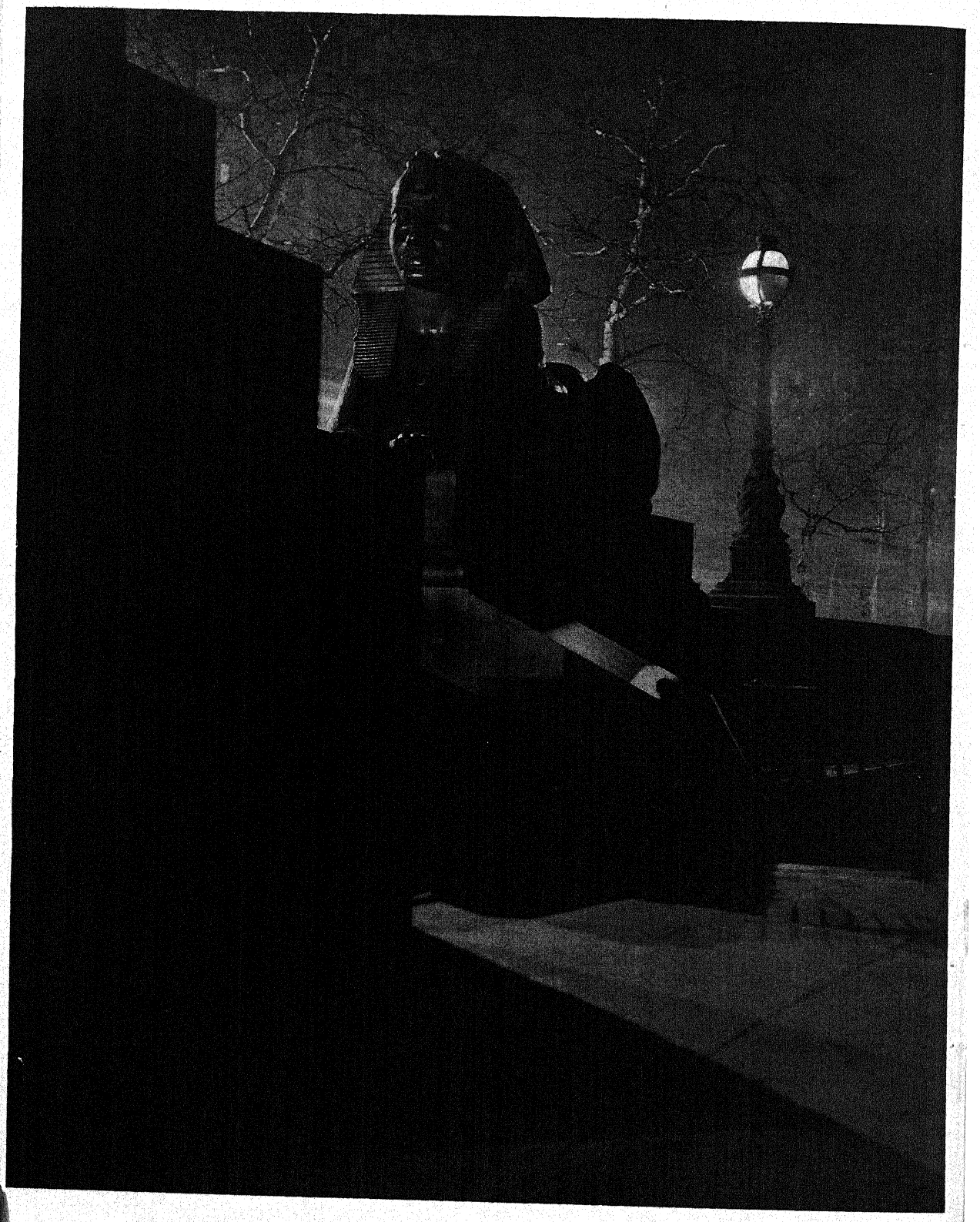
W. G. Briggs, F.R.P.S.

Leica ; 1/16 sec., f9, Agfa Isopan F ; no filter. *See article on Botanical Photography (pp. 185–186)*



KESTREL BRINGS FIELD VOLE TO YOUNG Eric J. Hosking

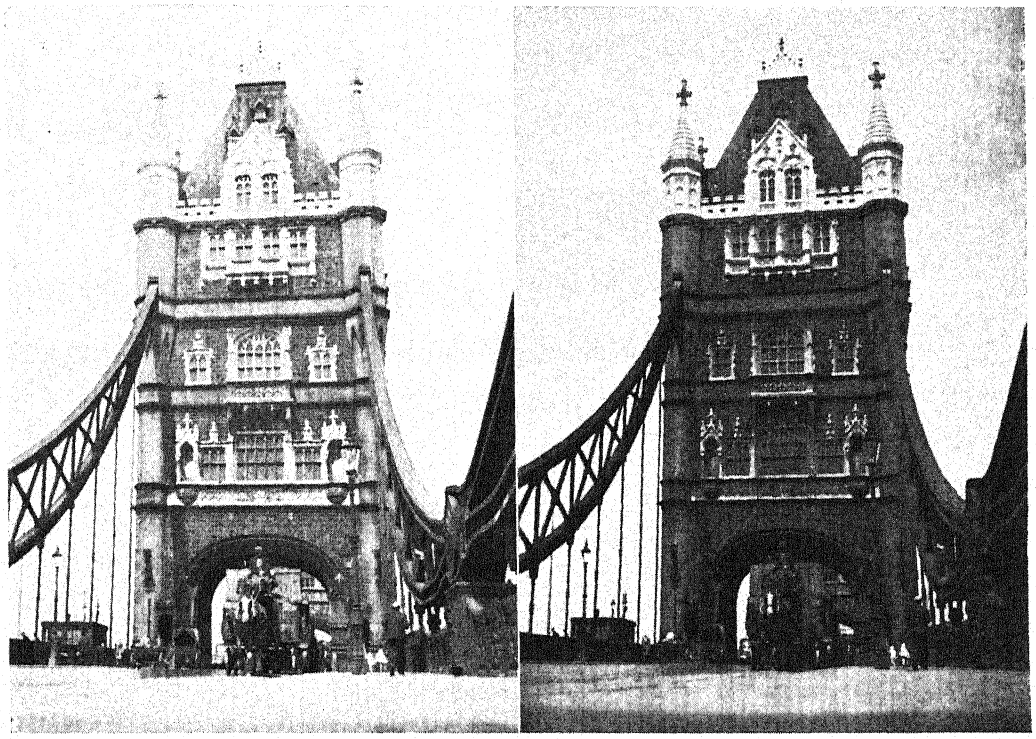
Quarter-plate Reflex Camera with 8-in. Serrac lens; exposure 1/10 sec. at f11, Ilford s.g. pan. plate. *See article on Bird Photography (pp. 170–183)*



THE MYSTIC

H. B. Burdekin

From "London Night," by H. B. Burdekin and John Morrison; Zeiss Nettel Press Camera, Ilford s.g. pan., 10 mins. at f8



WRONG EXPOSURE, TWO FORMS. Bromide papers, like plates or films, produce a faint, slowly appearing image (as on left above) when under-exposed, and a quickly appearing, over-dark image (right) when over-exposed
Photos, David Charles

bulk of water and adding more bromide of potassium to the developer, but usually a print produced under such conditions will lack vigour and present a flat appearance and be of bad colour. If, however, it is known before applying the developer that the print has received an excessive exposure, development with a dilute developer, restrained with bromide of potassium, will, after prolonged development, produce a warm-toned print of fair quality.

If the exposure is right, development will be complete in about two minutes. With good negatives and correct exposure, provided the development is carried far enough, there is little likelihood of over-development, as the action will stop almost entirely. This is known as "developing to infinity."

When the print is fully developed it is rinsed and placed straight into the fixing bath, or, if a number of prints are being made, a stop bath can be used. In this the developing action is stopped entirely, and the prints can soak until they can all be transferred to the fixing bath. This procedure also prevents contamination of the fingers with the hypo fixing bath—which would be fatal if any of it reached the developer, and is a prolific source of stains when it occurs. The stop bath is compounded of half an ounce of acetic acid in 25 ounces of water.

The fixing bath for bromide prints consists of :

Hyposulphite of soda	3 ozs.
Metabisulphite of potassium	½ oz.
Water	20 ozs.

It pays to use plenty of fixing solution, in a dish a good deal bigger than the prints, and to allow ample time for fixing. Up to half an hour will do no harm, and the prints should be well moved round and separated from time to time. To ensure complete fixation it is advisable to use two hypo baths. Not only does this enable a greater number of prints to be fixed without overcrowding, but also it permits of the completion of the fixing process in a fresher and stronger bath. The prints are fixed first in bath No. 1, and after a quarter of an hour are transferred to bath No. 2.

After fixing the prints are washed for half an hour in running water, or in a dozen changes of clean water, allowing the prints to remain for five minutes in each change. After washing the prints should be blotted with fluffless blotting paper and pinned up to dry. The edge of a wooden shelf is suitable for the purpose. Large prints may be suspended by clips from a line across a room. Drying can be hastened, if necessary, by soaking the prints in methylated spirit after leaving the last washing water. When dry they are straightened by passing under the edge of a flat ruler.

Abrasion or stress marks which sometimes occur on the surface of the prints—especially seen in the whites—can be removed when the print is dry by rubbing with cotton-wool wetted with methylated spirit. These marks occur most frequently on glossy-surfaced bromide paper, particularly if the development has been forced.

Brown Tones on Bromides

Brown or warm tones can be secured on bromide paper by development by greatly increasing the exposure and using a very dilute and highly restrained M.Q. developer, but the method is uncertain. Pyro-acetone has been recommended, and the following formula will produce brownish colours with normal exposure on many brands of paper :

A

Pyro	22 grs.
Sodium sulphite	130 grs.
Sulphuric acid	3 minims
Water	1 oz.

B

Acetone	1 vol.
Water to make	20 vols.

Use equal measures of A and B. The colour may be further modified by increasing the acetone.

Another formula for brown tones on bromide paper by development is the following :

Stock Solution

Pyro	1 oz.
Potassium metabisulphite	½ oz.
Water to	10 ozs.

A

Pyro stock solution	1 oz.
Water to	10 ozs.

B

Sodium carbonate	1 oz.
Sodium sulphite	2 ozs.
Water to	10 ozs.

C

Potassium bromide	1 oz.
Water to	10 ozs.

For normal development, take equal parts of A and B and five drops of C per ounce of mixed developer. This developer, with normal exposure, will give black tones free from stain with the greatest ease. As the exposure is increased the developer must be proportionately diluted with water and more bromide (C) added. The following table will be found useful :

Exposure	Developer	Colour	Time of development
Normal	Normal	Black	1 to 2 mins.
One and half normal	4 ozs. normal Plus 20 minims (C) Plus 6 ozs. water	Warm Black	4 mins.
Twice normal	4 ozs. normal Plus 40 minims (C) Plus 10 ozs. water	Sepia	6 mins.
Three times normal	4 ozs. normal Plus 60 minims (C) Plus 20 ozs. water	Warm Sepia	10 mins.
Four times normal	4 ozs. normal Plus 80 minims (C) Plus 30 ozs. water	Brown	15 mins.
Five times normal	4 ozs. normal Plus 100 minims (C) Plus 40 ozs. water	Light Warm Brown	30 mins.

In practice, the time of development and the tones vary a little according to the freshness of the solution and the temperature.

Restoring Stale Paper

Bromide paper that has been kept a long time and become stale will probably give very poor, flat and discoloured images if used in the ordinary way. Here is a method of restoring it which also applies to bromide paper that has been fogged by accidental exposure to light. Make up this bath :

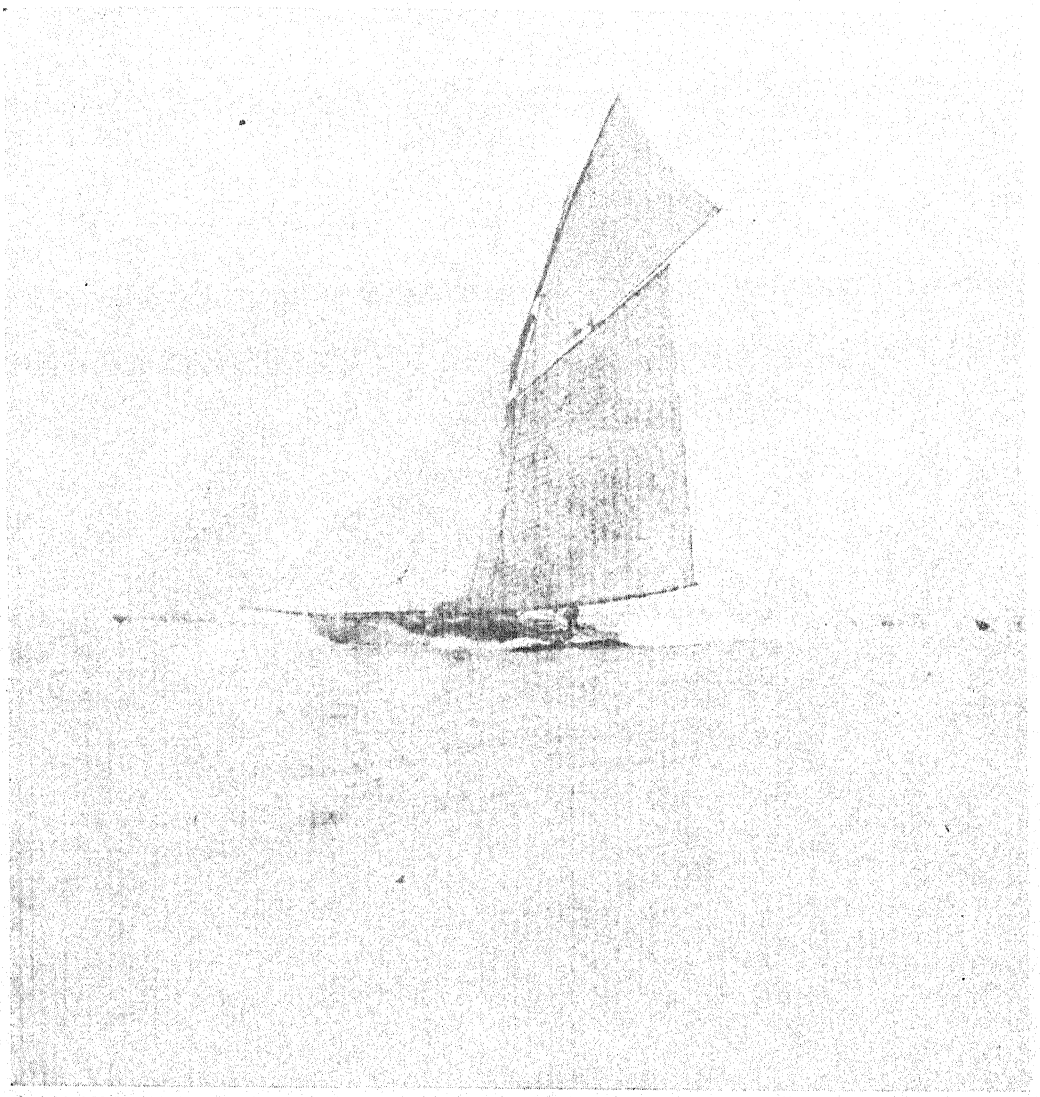
Potassium permanganate	5 grs.
Sulphuric acid	30 minims
Water	50 ozs.

The stale or fogged bromide paper is soaked in this solution for a minute. It is then transferred to :

Sodium sulphite	20 grs.
Water	1 oz.

Leave for another minute, rinse and the paper is ready for use. It may be exposed at once in a wet condition, or can be dried (in the dark-room, of course). The speed of the original paper is decreased approximately one-half by this method.

If an exposed sheet of bromide paper is rinsed in a very dilute solution of potassium bichromate, and then developed, the range of gradation is considerably lengthened and " soft " prints can be obtained from



A 'HIGH-KEY' PRINT. High-key work is more dependent on the quality of the negative than on making the print. It is essential in the first place that the subject should be suitable for this treatment (like the above picture of a summer morning at Cowes), and it is necessary that it should be light in tonal quality, and that there should be an abundance of light available for rendering it. When these factors are present a full exposure, followed by short development, will produce a negative that will give a direct print on normal bromide paper, in which there is a range of tones, of which the darkest is in the middle register, without any suggestion of flatness. Dark-toned subjects or subjects with heavy shadows are unsuitable for this treatment

Photo, F. J. Mortimer

" hard " negatives, or a " hard " paper can be practically converted into a " soft " one. The process, which is called the " Sterry " process, after the name of its inventor, is particularly applicable to the making of enlargements from very hard negatives.

The following 10 per cent. stock solution of potassium bichromate is made up as follows :

Potassium bichromate	1 oz.
Water to make up to	10 ozs.
Strongest ammonia (·880)	1 dr.

Fifty to 100 minims of this solution is added to 10 ounces of water.

When making a print or enlargement from a very harsh negative, the first thing is to ascertain the exposure which will bring out the detail in the highest lights (neglecting all else) when developed in the usual manner. Then make a dilute solution of the bichromate as above, the actual strength required for any particular negative or grade of paper being quickly learnt after a few trials, and

thenceforth may be judged without trial. Make the full exposure as above indicated, and immerse for three minutes in the diluted bichromate bath, preliminary rinsing with clean water being necessary only in large sizes of paper to keep them flat. Wash for half a minute, and then develop in the ordinary developer in the usual manner. It will now be found that, although development is somewhat slower than usual, the density is held back and the resultant print has a full range of tone values. An acid fixing bath should be used, as there is then less liability to staining. Should such stains arise, they may be removed by soaking in a saturated solution of alum, after thoroughly fixing and washing.

Recapitulation and Final Hints

(1) A rapid bromide paper gives a softer, less contrasty print than a slow paper. For harsh negatives use a more rapid or "soft" paper, or employ the "Sterry" method. For flat or thin negatives it is necessary to use a slow or contrasty grade of paper.

(2) Very rough papers are not suitable for small prints. Use smooth, matt, "velvet" surface or glossy paper for these. The rougher surfaces are more adapted for big exhibition prints. Cream-base papers suit warm-toned subjects, and are not suitable for, say, snow scenes.

(3) Prolonged exposure tends to reduce contrasts. Shortening the exposure, within certain limits, or reducing the intensity of the printing light will accentuate the contrasts of the print.

(4) For soft effects and "high-key" pictures give a full exposure and use a dilute developer, but do not carry development too far. For bright, sparkling effects, reduce the exposure to the practical minimum and use a strong developer.

(5) Stains or marks on the print may be due to a variety of causes, such as stale paper, hypo contamination in the developer, or dirty dishes or measures. The remedy here is obvious. Stains may also be caused by allowing developer to remain on the prints, and not turning the prints or keeping them completely submerged in the fixing bath. Stale or exhausted developer, especially if the exposure has been under-estimated, will also tend to produce yellow stain. Clear-edged markings and circular marks may be due to uneven flow of the developer in the first place. The remedy is to wet the print thoroughly with water before applying the developer. The circular marks—large or small—may be due to air bubbles forming on the surface when developing.

(6) Over-exposure is indicated by the print being flat, wanting in contrast or sunken in. The whites even may not be pure, but show signs of reduced silver; the image is also a dull grey and contains no rich blacks. The obvious remedy is to shorten the exposure, but the over-exposed print may also be improved by a process of intensification, followed by clearing to restore brightness to the high-lights.

(7) An under-exposed bromide print is generally of extreme contrast, the shadows black and heavy, and the high-lights wanting in detail and showing bare patches of paper. Increasing the exposure is the only remedy, and an under-exposed print had better be thrown away at once.

(8) If the print is flat and wanting in contrast, and does not even show white paper under the pins or bands which hold it on to the easel, or round the edges that have been protected by a mask, the paper has probably been fogged by stray actinic light. The room in which the prints are made, and the enlarging lantern, if such be used, should be examined for light leakage. Such a print may be improved by slightly reducing, washing, thoroughly converting the image into silver chloride and re-developing.

(9) The same dish should not be used for developing and fixing, and on no account should hypo be allowed to contaminate the developer. Wash the hands frequently during developing, and dry on a clean towel. Keep all dishes clean after use. If the hypo solution is splashed on to the bromide paper, or transferred to it from the clothes of the worker at any stage before fixation, stains will result. Stains may also occur if prints are allowed to float face upwards in the fixing bath with parts of their surfaces exposed to the air. The remedy is obvious, and all prints during fixing and washing should be kept submerged and moved about at intervals.

BROMOIL: PIGMENT PROCESS EXPLAINED

F. J. Mortimer, *Hon. F.R.P.S.*

Editor of 'The Amateur Photographer' and 'Photograms of the Year'

The bromoil process is a highly artistic method that has been much misused in photography, either through inexpert handling or through a wrong idea of its use and purpose. The following article, by a pioneer of the process, should do much to eradicate such errors and misconceptions

THE desire for greater control of tones and details in a photograph invariably occurs at some period in the career of the amateur photographer who seriously sets out to make pictures. The pictorially minded worker strives to make the most of straightforward methods of negative and print making that are available to him, and endeavours to secure his effects by careful selection of viewpoint, choice of time of day, correct exposure and development, and finally a suitable printing process.

In spite of all these possibilities exploited to the full, he may yet produce a print that, though technically perfect and as nearly as possible a faithful record of the subject portrayed, is a failure as a picture. The subject itself may be imperfect, and the photograph may fail to possess those tonal values which make all the difference between a clean-cut snapshot and a result embodying that subtle and satisfying thing known as pictorial "quality."

Perfect Control

To achieve this there are various expedients available to the photographer, but none that provides so complete a method of control in the final print as the bromoil process.

This process offers many advantages in addition to that just mentioned. It is founded on a bromide print as a working base. This in the first place permits a great variety of contrast quality in the making. It can be conducted entirely by artificial light, the prints can be made in any size by enlarging, and with a choice of many surfaces. The bromoil itself can be made in any colour, and the final result is a product in oil pigment—as permanent and lasting as the paper base itself.

From the foregoing it might be assumed that bromoil is the ideal process for picture making and should be universally employed. Unfortunately, like all processes that are largely under the manipulative control of the individual, it is not always used in the best manner, and unless it is directed by an artistic brain that knows exactly what is wanted, the result may be deplorable. A bad bromoil print is a very poor thing indeed, and it is a mistaken idea that bromoil is a panacea for indifferent photography.

Use Only the Best Bromides

As mentioned above, the starting point for making a bromoil is the production of a bromide print. This should be a correctly exposed and fully developed print with a full range of tones from black to white. This, in turn, connotes a good negative, and while, in expert hands, a poor bromide made from an indifferent negative may yield a passable bromoil, to secure the best results the very best bromides should be employed.

The process is briefly as follows: The bromide is bleached in a solution that produces a tanning action in the gelatine in proportion to the depth of the silver image. The darkest parts of the picture, *i.e.* those containing most silver, are most strongly tanned—the half-tones in varying degrees according to their strength and the highest lights of the picture are acted upon very slightly or not at all.

The black and white image is thus converted into a practically colourless image that is represented by different degrees of hardness in the gelatine coating. If the print is now soaked in plain water at about 75° F., the gelatine will absorb the water and swell slightly in exact proportion to the amount of tanning it has received, and the picture will be visible in very low relief.

If an oil pigment or greasy ink is applied to the surface of this prepared gelatine surface, the parts that hold the most water will repel the pigment, while others that are

hardened and hold little water will " take " it. The process is strictly proportional through shadows, half-tones and high-lights, so that if the application is skilfully done the entire picture can be built up in pigment and take the place of the original silver image. In so doing, however, as the pigment is applied with a special type of brush, the personal control of the worker comes into play, and the requisite strengthening of shadows, darkening of objectionable high-lights or lightening of half-tone passages, are carried out until the desired result—a perfect picture in oil pigment—has been produced.

Use the Special Papers

Although any good make of bromide paper may be used, and almost any surface may be pigmented, the bromoil worker—especially the beginner—is strongly recommended to use the special " bromoil " papers that have been put on the market by different makers. These are bromide papers of fine quality, made with special emulsions rich in silver and gelatine, that react easily to the process and ensure good results so far as the preliminary stages are concerned. The final picture is always a matter for the individual.

These bromoil papers are handled precisely as ordinary bromide papers.

As the quality of the bromide print has a definite bearing on the resulting bromoil, the procedure referred to under " Bromide Printing " should be studied to arrive at correct exposure by means of trial strips, followed by full development, to get the strongest deposit of silver in the shadows.

While it has been stated that any bromide paper will serve as a base for the bromoil print, this statement must be modified to the extent of excluding some of those papers which are described as having a " platino-matt " surface. This is a very smooth surface paper, quite capable of producing bromide prints of fine quality; but as the emulsion employed in the manufacture contains a certain proportion of starch or similar substance, it is not ideal for the bromoil procedure. The papers for bromoil must be essentially gelatino-bromide, in addition to the special bromoil papers themselves.

The ideal developer for the production of a good bromide print that is to be converted into a bromoil is amidol. The following is a reliable formula that can be employed:

Sodium sulphite (cryst.)	1 oz.
Sodium sulphite (anhydrous)	½ oz.
Potassium bromide (10% soln.)	20 minims
Amidol	50 grs.
Water to	20 ozs.

These chemicals should be dissolved in the order given and a fresh solution made up for each batch of prints, as this developer does not keep for more than a day or two.

The only other developer that is recommended for the production of a perfect print for bromoil is metol-hydroquinone, although some of the one-solution concentrated developers have been used successfully. In any case, the developer must be above suspicion of exercising any tanning action, and it is for this reason that amidol is particularly suitable for the purpose. Pyro, for instance, would be entirely unsuitable because of its tanning tendencies. The following formula will work well, and it is possible that any M.Q. formula will be equally suitable, provided it is of the " low contrast " type, with a smaller proportion of hydroquinone than usual:

Metol	20 grs.
Sodium sulphite (anhydrous)	300 ,,
Hydroquinone	45 ,,
Sodium carbonate (anhydrous)	220 ,,
Potassium bromide (10% soln.)	30 minims
Water to	20 ozs.

The ideal print for bromoil is one that when taken from the fixing bath and examined by transmitted light shows good detail throughout the entire range of tones, especially in the stronger shadows.

Care in Fixing Essential

The fixing bath is a matter also worthy of careful attention in the production of the bromide print for bromoil. It should be of the non-acid variety, and without any hardening element included. The gelatine surface of the print is particularly susceptible to any ingredients in the developer or fixer that may have an effect that is equivalent to tanning, and this plays an important part in the receptivity of the print later to the oil pigment.

The fixing bath must, therefore, be a plain hypo solution, in a proportion of 3 ozs. to a pint of water, and fixing should be continued for 15 minutes, followed by thorough washing. The print can then be

dried in the ordinary way and kept for subsequent bleaching, or the bleaching process can be proceeded with immediately.

The former method has an advantage in that the thin gelatine film of the print is less likely to get damaged if it is allowed to dry first.

The bleaching and tanning of the bromide print, preparatory to its being pigmented, introduces several factors that have to be observed carefully if success is to be ensured.

Bleaching Baths

Numerous bleaching baths have been suggested. The bleacher can be made up either in one or two solutions. Of the first class the following is very reliable :

Copper sulphate (10% soln.)	6 drs.
Potassium bichromate (10% soln.)	2 ,,
Potassium bromide (10% soln.) ..	4 ,,
Pure hydrochloric acid	2 minims
Water..	9 ozs.

Another, which is due to Mr. Raymond Crowther, is :

Copper sulphate (10% soln.)	340 minims
Potassium bromide (10% soln.) ..	260 ,,
Chromic acid (1% soln.)	90 ,,
Water..	7 ozs.

A good two-solution formula, which is due to Mr. C. J. Symes, is :

A.	Cupric chloride	160 grs.
	Sodium chloride	2¾ ozs.
	Hydrochloric acid	3 minims
	Water	10 ozs.
B.	Potassium bichromate	55 grs.
	Water	10 ozs.

It will be noted that in this formula A is the bleaching element and B the tanning element.

For use, take one ounce of each and add two ounces of water.

If the bromide print has been dried, it should be soaked for five minutes in plain water before bleaching and tanning. This should be conducted at a temperature of approximately 65° F., and the subsequent processes should also be kept at this temperature. The preliminary soaking is to ensure uniform bleaching.

It is important that clean dishes should be used, and the bleaching solution should not be stinted. It can be poured direct on to the print in the dish with an even sweep, and the dish rocked during the process of bleaching. The image will gradually disappear until it is of a very faint greenish brown colour that is almost invisible seen through the bleaching solution. With a freshly made bleacher and a properly prepared print the bleaching should be complete in three to four minutes. If the image is very slow in bleaching and the shadows refuse to change, the operation may have been conducted at too low a temperature, or the fixing and washing of the print may not have been properly conducted. In the latter case complete tanning becomes difficult, and if prolonged may produce a universal tanning action over the entire surface that will render production of a good bromoil practically impossible. To ensure correct results the bleacher should not be used for more than one fairly large print, although two or more small prints can, of course, be bleached in one bath.

After the print has been bleached it should be washed for ten minutes at least, or in several changes of water until every trace of yellowness has gone from the high lights and from the washing water. If the washing is not done thoroughly, some of the solution may be carried over into the next bath and a general tanning of the entire print may take place.

Fixing Baths and Soaking

After bleaching, the print is transferred to a fixing bath, which is made up as follows :

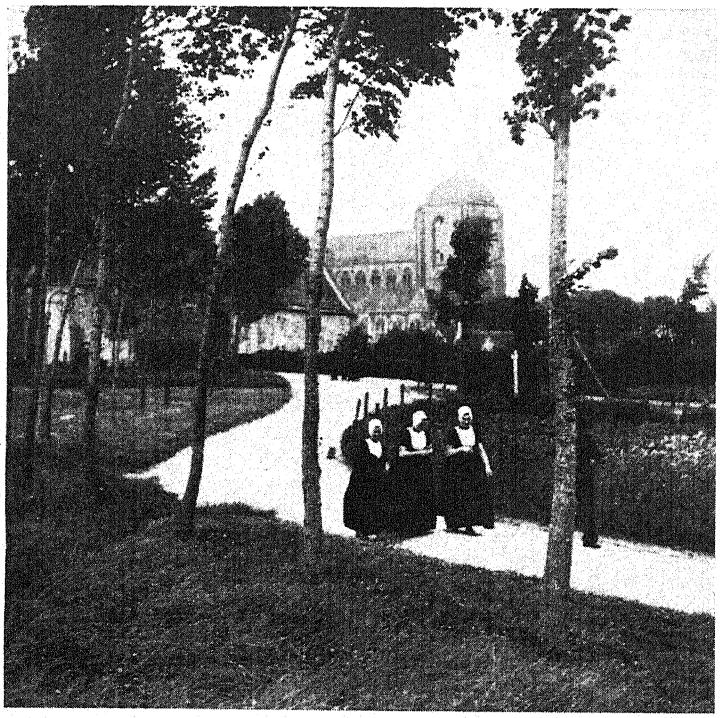
Hypo	2 ozs.
Sodium sulphite	1 oz.
Water..	20 ozs.

Some workers obtain their best results by using a slightly acid fixing bath at this stage. The following is recommended :

Hypo	2 ozs.
Metabisulphite of potassium	10 grs.
Water..	2 ozs.

In the fixing bath the faint greenish brown image that remains changes to a very pale grey, and with some papers becomes practically invisible. After fixing for five minutes the print is well washed for half an hour to remove all trace of the hypo. It is then ready to be pigmented at once, or it may be dried and subsequently resoaked in water for pigmenting at a later date.

The soaking of a dried and bleached print is also a matter that must be conducted carefully ; both time of soaking and temperature of the water will affect the result. The temperature should be as near as possible 75° F., and for most bromide and bromoil papers 20 to 25 minutes will be sufficient time. At this stage, if the bleached



the bleached print preparatory to pigmenting. When this part of the process has been properly conducted, the print is in good condition for taking the ink, and the subsequent pigmenting is rendered easier and more certain.

To prepare the print for the application of the ink, it is taken either from the last washing or from the plain water which has been used for re-swelling, and placed on a piece of plate-glass of a larger size than the print. Some workers prefer to place a sheet of wet blotting-paper on the glass before placing the print on it, as it is necessary for the print to remain damp throughout the

print is examined, it will be found that the image is clearly to be distinguished in very low relief. This can be observed by removing the print from the water and viewing at an oblique angle. A better test for ascertaining correct condition for pigmenting is by sense of touch. Feeling the surface of the print will indicate that the highlights of the picture which are fully charged with water are more swollen and slightly "slippery" to the touch, while the shadows which are harder and hold very little water are definitely harder and in some cases almost rough to the touch.

This preliminary preparation of the print is very important in the production of a bromoil, particularly the swelling of



BROMOIL: THE FIRST STEP. The upper of these two photographs is the bromide print selected as a suitable subject for the bromoil process. Beneath is the bleached print partly inked up to show the control that becomes possible with the brush action, as the print develops under the application of the oily pigment
Photos, F. J. Mortimer



THE FINISHED BROMOIL. Here is seen the final result of the process, of which two of the earlier stages are shown in the opposite page. An inestimable improvement has been wrought, good though the print seen opposite is, the effect being now no longer that of a mere photograph, but having a resemblance to the work of an old master of the Dutch school

Photo, F. J. Mortimer

whole process of pigmenting. It will be quite obvious that for the gelatine to reject or accept the ink in its various parts it will be necessary for the water to remain in it.

In the earlier days of bromoil it was recommended to work a print on a thick pad of wet blotting-paper, so that the dampness was continued very thoroughly. This has now been demonstrated as unnecessary, as the following procedure will indicate.

The well-soaked print, when laid face upwards on the plate glass, is first swabbed over with a piece of cotton-wool to remove any deposit left by the bleacher. The surface is then blotted gently as the gelatine is in a very delicate condition. The moisture may be removed either with fluffless blotting paper, or, better still, by lightly dabbing with a thoroughly washed, light, linen handkerchief. When there is no water to be seen on the surface of the print the image should be visible in slight relief, the high-lights being shiny in appearance and the shadows dull.

The print is now ready for pigmenting, but first a word about the pigment itself or, as it is frequently called, "ink," and the brushes for applying it.

The special brushes are similar in appearance to stencil brushes, but with the tops



BROMOIL APPARATUS. A set of bromoil brushes, palette knife, pigment in tube and bromoil medium. These, with a suitable palette, are the tools necessary for making the bromoil print. It is not necessary, however, for the beginner to have so many brushes as those indicated above. The medium-sized brush shown in the middle of the group, and two of the smaller ones, would be sufficient. The centre brush (No. 15 size) has a circumference at the top of about the size of a penny

made askew, and are described as " stag-foot," in that they resemble the hoof of a stag in shape. The best are made of genuine polecat hair, others are of imitation fitch, and in some of the larger sizes fine hog-hair is employed. One at least of the large sizes should be obtained, especially if big prints are to be bromoiled, and two smaller ones will also be necessary. The sizes to be recommended are those known as Nos. 6, 10, 15, 20, 24 and 28, the last being the largest made. One or two smaller brushes are useful for fine work and touching up.

The " inks " are supplied in tubes by dealers who specialize in bromoil materials. They are somewhat similar to ordinary artists' oil colours, but much stiffer in consistency. Two of the best are those known as " Encre Taille Douce," which is soft black ink, and " Encre Machine," which is harder. These are akin to lithographic inks and are of French manufacture. Inks for bromoil are supplied in a variety of colours, but the worker will be wise to restrict his preliminary efforts to the black inks mentioned above.

A " medium " for thinning the ink when necessary will be wanted. This can be ordinary artists' megilp, obtainable in tubes, and only a small quantity is required. A palette is a necessity, but this can be a piece of plain glass ; it should be placed on top of a sheet of white paper, so that the consistency of the ink may be observed as it is worked up. A palette knife, or an old table knife that has been worn down, is also useful for working the pigment on the palette, and some petrol or similar cleansing agent will be wanted for cleaning the brushes, palette, and other apparatus.

We are now at the point when the wet bleached print is on the plate glass slab, with its surface bleached and ready for pigmenting.

A little of the hard pigment (Encre Machine) is spread on the surface of the palette, as evenly as possible, with a palette knife. The largest brush is now taken and dabbed on the patch of pigment on the palette so as to take up a little on the ends of the hairs only. It is then tapped a few times on a clear portion of the palette to spread the ink and to get the whole top surface of the brush evenly covered. The brush should be held lightly, almost vertically, and nearly at the end, by the thumb and two first fingers. Held in this manner a slight dabbing, " caressing " action can be given, and it is this " touch " that constitutes the chief secret in the making of a successful bromoil, apart from the technical preparation of the print.

In building up the print, the ink is applied where it is required and this can only be done by lightly dabbing it on in this manner. After a little practice the beginner will acquire the correct action. If the downward touch is emphasized with a gently pressing action on the surface of the print, more ink is deposited, while if a sharp hopping action is given in which the brush taps the surface and is then sharply withdrawn, that portion of the print will be lightened; and if conducted more strongly, with a definite " bouncing " action, will take the pigment

away completely. "Hopping," however, is not advocated unless absolutely necessary, as it tends to damage the soft gelatine surface.

When starting to ink up a bromoil, a spot should be chosen where the subject shows a strong contrast—such as the trunk of a tree against the sky. If the pigment is applied to that part it will at once be seen whether the print is in good condition. The colour should take immediately on the shadow portion and be rejected where there are high-lights.

As the dabbing proceeds, more ink is taken up from time to time from the palette and transferred to the gradually growing image, until the entire surface is worked over and the subject fully developed again in pigment.

Gentleness Does It

After a little practice the action will become almost automatic, but should be as gentle as possible; in some cases the weight of the brush itself is sufficient to deposit the requisite amount of ink. No notice should be taken of small hairs that may be shed by the brush. These are easily removed when the print is dry; never attempt to remove them from the damp print.

The print must be kept in the right condition of dampness until all the pigment has been applied; a tendency for the high-lights to ink up is a sign that the surface is getting dry. At the same time care should be taken to keep any water from the brush itself. If water gets on the brush, or spots of it on the print itself, the pigment will refuse to take. The margins of the glass should be quite dry before starting to apply the pigment.

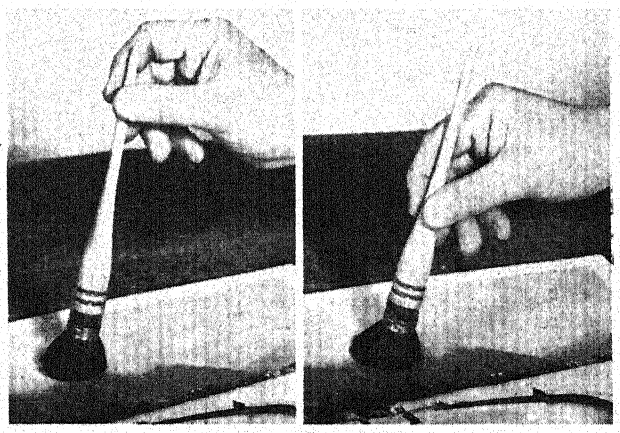
The surface of the damp print will remain in good condition from a quarter of an hour to twenty minutes according to the temperature of the room, and as it may take longer than this to ink up a large surface the print must be re-wetted. If it is not too dry it can be brought into good condition again by floating it on plain water for ten minutes, after which pigmenting can be resumed. If, however, it has become quite dry, the entire print must be immersed in water at the room temperature for five minutes. It is then replaced on the glass and the surface carefully blotted again before continuing brush work.

If the print refuses to take the ink readily, this indicates that it has been over-soaked and too much water has been absorbed by the entire surface. It will be found in this case that allowing it to dry for a short time will generally restore the surface to proper working state.

When the reverse happens and the pigment takes all over the surface, both high-lights and shadows, this indicates either that it has been under-soaked or that some general tanning action has taken place. This, as mentioned previously, happens when the washing between bleaching and fixing has been insufficient and the gelatine has received a certain amount of hardening action in the high-lights. In the latter case nothing can be done, but if the trouble is due to under-soaking the remedy is obvious.

It is always best to start pigmenting with a hard ink, and later to add a tiny spot of medium to thin it slightly and enable the half-tones to build up more readily. It is also possible to thin the hard ink with a little of the softer variety.

The ideal to aim at at first is to reproduce the exact tones of the original bromide print without attempting control of any sort. When the beginner can do this readily, he will



USE OF THE BRUSH. Left, the correct method of holding the bromoil brush for regular pigmenting. It is held lightly, near the top, and gently dabbed or tapped on the surface of the print, after being charged with ink from the palette. Right, a firmer grip of the brush and a gently pressing action, is given when more pigment is to be deposited on to the surface of the print

Photos, F. J. Mortimer

have gained sufficient mastery of the process to attempt control.

Control in bromoil pigmenting is the greatest asset of the process. This can be exercised when high-lights have to be darkened, such as spots of light showing through the trees, or patches of high-light near the margin of the print, etc., or when it is necessary to lighten shadows or to strengthen them to produce a greater concentration of interest in the composition. The shadows can be lightened by the "hopping" method already described, or the shadows strengthened by adding a little more ink where required.

To avoid graininess in the finished result and to produce a finer texture, the print should be gone over again with a nearly clear brush to soften all tendency to grittiness, as the picture will always appear with more grain when dry than when wet.

When quite dry, which will take in normal temperatures about a couple of days, the surface of the print can be cleaned up with a dry camel-hair brush and spotted where necessary with a little of the pigment itself. Stray hairs can also be picked off in the same manner, and high-lights can be cleaned up where required with a piece of soft rubber.

If an entirely matt surface in the pigmented print is desired the glossiness can be removed by placing it, when perfectly dry, in a dish containing either a non-greasy grade of petrol, or carbon tetrachloride. Great care must be taken, however, not to rock the dish, and to lift the print from the bath very carefully or the pigment may shift. This process is known as defatting.

Some final points are worth impressing on the beginner in bromoil:

Throughout every stage of the process perfectly clean dishes should be used. These should be chemically cleaned with a little dilute hydrochloric acid, and well washed before use, as there is always the danger of accidental tanning of the image where not required.

Tanning action in the wrong places will often account for the print taking the ink all over, although this may be caused by insufficient soaking, or by the print drying too quickly in a warm room.

The refusal of the ink to take is generally due to over-soaking, and can be remedied by allowing the print to dry a little and by using softer pigment.

In some cases reversal takes place when inking, and at first a negative appears instead of a positive. This may be due to insufficient washing of the bromide print, and the presence of hypo or developer which has not been completely removed. If hypo is present it will also tend to produce irregular streaky lines, as the tanning action will have been uneven. Reversal is occasionally caused by hard water which may have been used in the bleaching solution.

If for any reason the pigmenting is unsatisfactory, it can be entirely removed with a swab of cotton-wool soaked in petrol.

When the pigment is entirely removed, the surface should be allowed to dry and then resoaked. If the print pigments with excessive contrasts it indicates that soaking has been conducted at too high a temperature. In this case, the print should be cleaned and dried and resoaked at a lower temperature.

BROMOIL TRANSFER: ITS NATURE & USES

The advantages of bromoil over other processes for transfer work are here explained by Mr. F. J. Mortimer, together with practical instructions for obtaining the best results

An interesting and important extension of the bromoil process is that known as bromoil transfer, which is analogous to processes such as collotype, in which a matrix is prepared with ink or pigment on a bichromated gelatine base, from which the entire picture is transferred to a new base.

In the case of bromoil the pigmented print can be regarded as the finished production, or it may be used as a matrix from which the image can be transferred to another sheet of paper.

Bromoil transfer in this way carries the process a step further and, incidentally, produces a result from which the photographic and gelatine base has been eliminated —one that is entirely in pigment on paper and is as permanent as the pigment itself. Above all, a good transfer possesses an artistic quality far in advance of any other process.

As with etching and other similar processes, the new base can be any suitable paper;

and, in fact, most good etching papers are the best for the purpose. It must be noted, however, that the image, in the process of transferring, becomes reversed from right to left. Therefore, if this would affect the subject materially, the original bromide print should be made with the negative reversed in the enlarger.

The preparation of the print for transfer is practically identical to that necessary for making an ordinary bromoil. There are, however, some points to observe which may affect the result, notably the quality of the bromide print itself. This should be of slightly more contrast and strength than is required for an ordinary bromoil. In fact, the original negative should also be of the contrasty type, and from this an enlargement of strong contrast will provide the best starting-point for bromoil transfer. It is desirable for successful transferring that the high-lights should be clear ; a slight veiling tone is not objectionable in a good bromoil, but, when present, will not produce the clearest transfer.

When the bleached, fixed, washed and dried print is resoaked in preparation for pigmenting, care must be given to time and temperature in order to obtain the best results for transferring, and only by experiment can this be ascertained for each particular paper that is used. As a rule, a normal bromide paper requires 25 minutes' soaking at a temperature of 70° F. Papers that are over-coated will require a shorter soaking at a lower temperature. Each make or batch of paper should be made the subject of test strips.

Making a Strong Image

The half-tones and high-lights transfer more readily than the shadows, and should therefore be pigmented first, using hard ink, and the bulk of the subject should be built up with this ink (Encre Machine).

This should be persisted in until as much strengthening as possible has been secured and only then should a little of the softer ink (Encre Taille Douce) be employed in order to get greater depth in the shadows ; but even this is not recommended if shadow detail is to be retained. Care must also be taken that the inking is conducted as gently as possible, and without recourse to " hopping," as the surface of the gelatine must not be abraded. If this happens, or if the ink is driven into the soft gelatine by heavy brush work, it will produce dull high-lights when transferred.

An essential for transfer work is a press through which the bromoil can be passed in contact with its new support.

In the early days of bromoil transfer work the domestic mangle was used for this purpose, and often with success ; but the unevenness of the rollers and the indifferent pressure obtained rendered the performance very uncertain. Proper transfer presses, with hardened rollers and adequate pressure, are now sold for the purpose. An etching press is, of course, ideal for the purpose.

Dealing with the Paper

The paper should be slightly damped, by placing it between sheets of wet blotting paper, and then between dry blotters, some time in advance of the transfer being made. It is in good condition for working when it feels limp but not damp. Dry transfer paper is not generally advocated, although it will produce more contrast. Some workers soak the transfer paper for five minutes in water about an hour before it is wanted, and then place it between sheets of blotting paper, to be ready by the time the bromoil has been inked. Other workers advocate spraying the paper with turpentine, and allow the spirit to evaporate before making the transfer. This frequently helps in making a complete single transfer of the image from the matrix. To ensure that the bromoil is in the best condition for transferring it should be given a final soak in water and blotted immediately before placing in contact with the transfer paper.

When making the transfer a firm support is necessary, such as a large sheet of zinc, or a piece of three-ply, larger than the largest size of transfer paper used. On this base a sheet of blotting paper is placed, upon which the piece of prepared transfer paper is laid, then the newly inked bromoil, and on this another sheet of blotting paper, then one or two pieces of printer's blanket, and finally a sheet of stout millboard.

The complete " sandwich " is then passed through the transfer press. The pressure for this is ascertained by experiment, but it

should be heavy, and if a mangle is used the rollers should be screwed down as hard as possible. The whole sandwich is then passed through the rollers and back again, slowly and deliberately without stopping. When the sandwich has been passed through the press twice the top board and blotting paper are removed, and a corner of the bromoil lifted from the transfer paper to see whether the whole of the ink has been transferred to the new surface. If it appears to be all in order the entire print can be stripped off, but if certain parts are still not transferred it should be replaced before the prints are entirely separated and run through the press again. This can be done several times if necessary, and some workers regard this "airing" of the print as an aid to complete transference of the image.

In any case, exact positions of the edges of the bromoil print should be lightly marked on the transfer paper in pencil, so that if the bromoil has to be re-inked for a second transfer it can be replaced in exactly the same position.

If the shadows, for instance, need strengthening, the bromoil should be resoaked for about 10 minutes and re-inked in those parts where greater strength is required. There should be no difficulty in securing correct register when placing the bromoil on the transfer paper again. One corner should be adjusted in position first, and the print then gently lowered into position on to the correct marks, taking care not to shift it. Re-inking and additional transfer can be repeated two or three times until the desired effect is secured.

If necessary, the bromoil can be masked with strips of thin paper so that the transfer shows a clean white edge all round, or the bromoil itself can be trimmed before transferring, though this is not so easily achieved without damage to the print. Some workers clean off a straight edge all round the pigmented print with petrol before transferring, leaving a narrow border to secure a "plate mark" on the transfer paper.

When dry the transfer can be readily spotted or retouched with chalks or spotting colours as required. The original bleached print or matrix can, after the transfer has been made, be cleaned with petrol or carbon tetrachloride and put away for further inking up and transfer—or it can be pigmented and left as a bromoil.

CAMERAS FOR GENERAL & SPECIAL PURPOSES

J. E. Saunders, F.Z.S.

Assistant Editor of 'The Photographic Journal'

The wealth of photographic apparatus at present on the market is apt to confuse one who wishes to choose a camera suitable to his needs. In this article not only is the beginner given a guide to all the main kinds and makes, but also the more experienced amateur or professional is enabled to bring his knowledge up to date, for all the latest models are included in this survey

See Box Camera; Miniature; Reflex, etc.

In its essentials a camera is simply a light-tight box with accommodation for a plate or film at one end and a lens at the other, with a shutter near the lens or near the plate or film to control the volume of light by which the exposure is made.

Endless variations in these factors are possible, and it is these variations which make a camera more suitable for one class of work than another. No camera is a truly "universal" camera, equally suitable for all purposes. Some of the de luxe miniature cameras, with a large variety of accessories, have widened the scope of popular hand-camera photography a great deal, but the fact remains that the photographer who adopts a specialized line of work usually finds that a specialist's instruments are needed.

The Seven Classes. The cameras in popular use in this second quarter of the 20th century can be roughly grouped into the following classes:

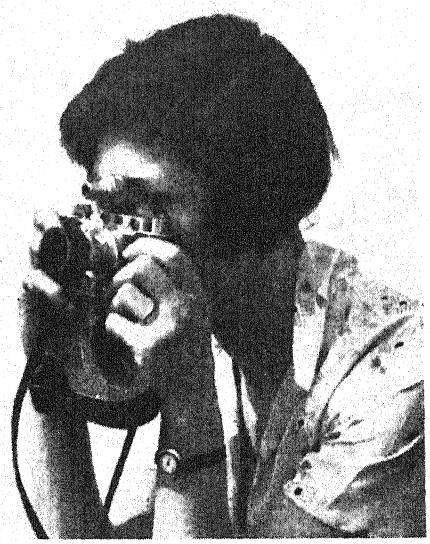
1. Popular "Snapshotting" Cameras. These, in their simplest form, use vest-pocket ($1\frac{3}{4} \times 2\frac{5}{16}$ in.) size roll-films or $2\frac{1}{4} \times 3\frac{1}{4}$ in. size, or half-size negatives (that is, 16 pictures on each orthodox eight-exposure spool). Cameras of this type include the box-form Brownies (a famous Kodak product), the Ensign All-Distance camera, the Zeiss Ikon Box Tengor, and many others which are sold at prices from 5s. to £1 or

25s. They generally have a shutter with only one instantaneous speed—1/25 sec. (*see* Box Camera).

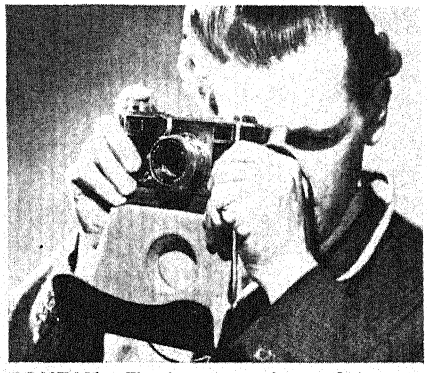
Next higher in the scale come the folding cameras of wood or metal construction, with bellows, which have simple inexpensive lenses, of moderate aperture, and shutters which enable speeds of 1/25 sec., 1/50 sec. and 1/100 sec. to be given. (Useful information regarding the handling of these cameras is given under Beginners: Hints and Tips.)

2. Superior Folding Roll-film Cameras. This popular class of instrument, with lenses of *f*6, *f*4.5 and even larger apertures, is usually made for the $2\frac{1}{4} \times 3\frac{1}{4}$ in. spools of roll-film, eight exposures per spool. Some of the newest have provision by which 16 half-size negatives may be obtained on these spools. They also have better shutters, giving a wide choice of automatic speeds.

Other popular cameras of this type are made for the $2\frac{1}{2} \times 4\frac{1}{2}$ in. spool, an attractive panel-shaped size, or may provide for 12 negatives each $2\frac{1}{4}$ in. square on a spool of $2\frac{1}{4} \times 3\frac{1}{4}$ in. film. So popular has this $2\frac{1}{4}$-inch square negative become, that firms have introduced films numbered 1 to 12 as well as 1 to 8. The postcard size (negatives $3\frac{1}{4} \times 5\frac{1}{4}$ in.) was once popular in roll-film cameras, but it has lost ground in recent years, and one rarely meets a postcard roll-film camera in Britain today.



LEICA. Using the universal view-finder, which can be used with any interchangeable lenses

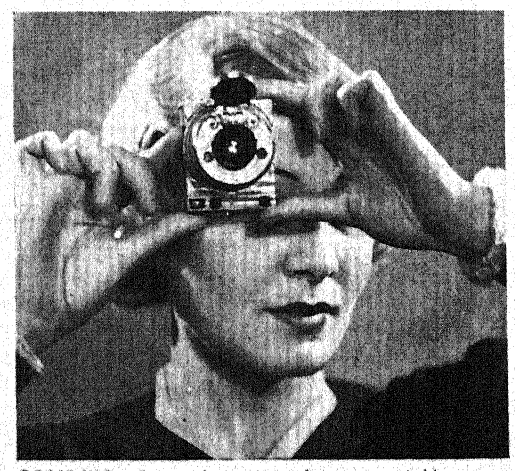


CONTAX. This has view- and range-finder combined in same eyepiece

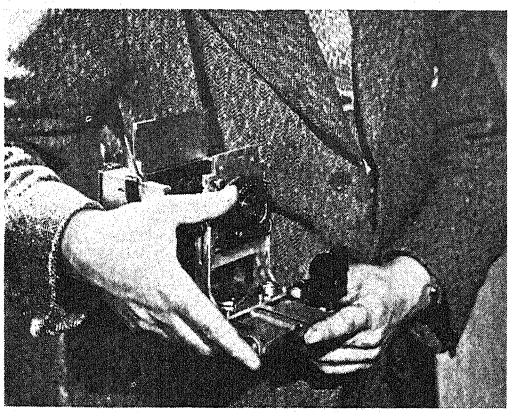
3. Miniature Cameras. The vogue of the modern "miniature" camera has been a great surprise to older photographers. The Leica (36 exposures of 36 × 24 mm. size on a spool) started the modern fashion, and its success and the number of its rivals have led experienced workers, as well as an entirely new public attracted by the exquisite precision qualities of these cameras, to adopt an instrument of this kind as their chief camera.

I know a large number of well-known amateur workers who have scrapped their heavy hand cameras, their bulky reflexes, their treasured plate cameras of bygone days, and have concentrated on Leica or Contax —and they have never lamented it.

Some miniatures of the last few years have become more miniature still! There are tiny precision cameras which produce film negatives less than an inch square, and the Compass, (*q.v.*), a remarkable little instrument

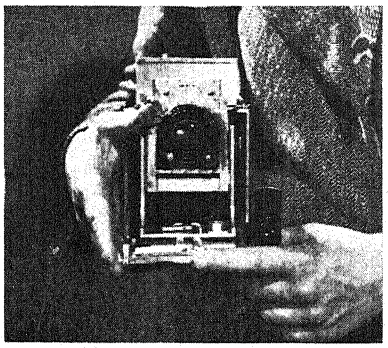


COMPASS. One of the smallest of these remarkable cameras

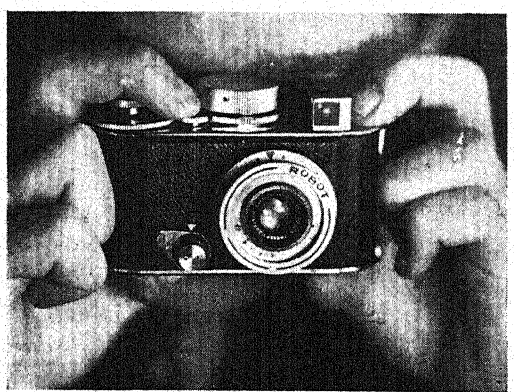


introduced in 1936 by a British company, uses glass plates and roll-film in 36 × 24 mm. size.

4. Hand or Stand Cameras. This type of instrument was, before the War and for some years afterwards, the beloved instrument of the amateur photographer who regarded himself as a "serious worker." It was most often of quarter-plate size or $2\frac{1}{4} \times 3\frac{1}{4}$ in., though there was, until recent years, a vogue for that pleasant size, 5 × 4 in. Postcard size was moderately popular before the War, when plates were cheap, but the difficulties arising from war-time conditions checked the popularity of all these large-size bulky instruments, which used plates and film-packs and sometimes roll-holders.



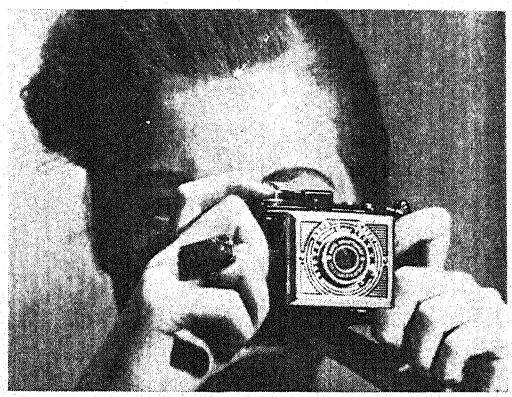
UNA. A stand camera used as a hand camera. The rising front is fully raised. At top it is seen from the side, and immediately above from the front



ROBOT Here the optical view-finder is also a right-angle finder, and is monochromatic. A trigger release sets the film and shutter automatically for a rapid series of exposures

Cameras of this type include the fine Zeiss Ikon range, the Sinclair Una, the Ensign Sanderson, the Adams Verto, and the Newman and Guardia Sibyl and Trellis cameras, Many of them have a rising front, so that the lens can be raised to cut off unwanted foreground material from the picture, and also to enable the photographer to deal more successfully with the upper parts of tall buildings. It is still a highly useful type of camera, which can be held in the hand for the exposure, and it employs scale focussing as well as focussing on the ground-glass screen. In many cases the camera has full double-extension bellows, very useful for copying pictures or photographing small objects in their natural size. Their solid baseboard permits these cameras to be fixed quickly on a small tripod, and then be used as easily and rapidly as a hand camera.

5. Stand and Studio Cameras. Some stand cameras are also called



AGFA KARAT. Showing the optical direct vision finder in use. The user has her finger on the shutter release. This is one of the most moderately-priced miniatures on the market

"field cameras." They must be used on pedestal or stand. They are now used chiefly by professional and commercial photographers for all kinds of work, including portraiture, commercial photography, engineering photography, and scientific work where rapid exposures are not needed. Many of them have triple-extension bellows.

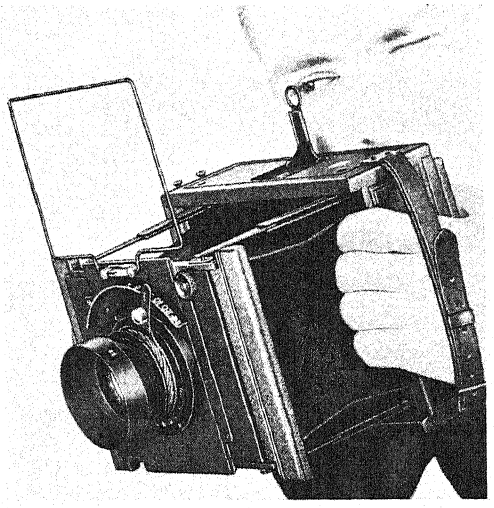
enabling lenses of long focus to be used. Generally they are made in half-plate size ($6\frac{1}{2} \times 4\frac{3}{4}$ in.) and other large sizes up to 12 × 10 in., 15 × 12 in., and even larger. One studio camera, without lens or stand, is priced at £85, and others cost £40 without lens; but half-plate field cameras with *f*7.7 lens and Thornton-Pickard roller-blind shutter can be bought for £10 10s. Few except professional workers now use these cameras; and in sizes below half-plate they are hard to find, even in the secondhand market.

6. Press Cameras. All sorts of cameras produce the pictures you see in your daily press, and in that sense any camera may be a "press camera." But the words are usually taken to apply to the handy collapsible camera of 10 × 15 cm., 9 × 12 cm., 5 × 4 in. or quarter-plate size, with a focal plane shutter (that is, a blind operating near the surface of the plate) and a lens of *f*4.5, *f*3.5 or one of even larger aperture in a focussing collar.

These shutters have high speeds as well as slow—speeds rated as high as 1/1000 sec. or even 1/2000 sec. The best known of these models in Britain was the Goerz-Anschutz, but its makers have discontinued that model as their public preferred the Nettel, which has automatic speeds ranging from 1/3 sec.



ZEISS IKOFLEX. The user is seen looking down into the reflex focussing screen



V.N. PRESS CAMERA. Showing the direct vision wire frame finder in operation

to 1/2000 sec. It is these high speeds which enable sports pictures, racing pictures and other rapid-action subjects to be recorded so successfully by those photographic wizards, the press photographers.

Some of the miniature cameras—the Leica and Contax in particular—have exceptionally efficient focal plane shutters with speeds as high as 1/1250 sec., and that is one reason why they lured the press photographer away from his bulky press camera. Nevertheless, the press camera of the orthodox type has not been entirely superseded by the miniature. A good camera of this type is, in fact, now being made in London—the V.N.

7. Reflex Camera. The mirror-reflex camera, such as the Soho, the Adams Minex, the Graflex and the Zeiss Ikon Miraflex, has long been a favourite instrument of the pictorial worker, the animal photographer and many types of keen amateurs, as well as a number of commercial and professional photographers who use it occasionally for purposes to which it is specially suited.

Its disadvantages are bulk and weight, particularly bulk. The reflex is focussed by the aid of a mirror which rests between the lens and the plate and throws the image caught by the lens on to a ground-glass screen at the top of the camera with a deep hood to shield the screen from the light. As you focus you see the picture as your lens will convey it to the plate. You can thus ensure that it shall be sharply defined or diffused in



CONTAFLEX. A Zeiss Ikon reflex camera taking miniature pictures on perforated 24 x 36 mm. cine film. There are twin lenses and a built-in photo-electric exposure meter

the negative as you wish ; you can see just what the boundaries of your picture will be ; you see whether a quadruped, for instance, will be represented as though it were standing precariously on three legs, instead of four ; at the right moment you press your trigger and it sends the mirror out of the way. As the mirror rises it releases the shutter. One great advantage of this type of camera is that the shutter is not attached to the lens but is built into the body of the camera near the plate, and thus you can employ lenses of varying focal lengths, especially that valuable instrument the modern tele-anastigmat, such as the Dallmeyer Dallon and Ross Teleros.

The disadvantage of bulk inherent to the older type of reflex camera has been lately overcome by the production of miniature reflex cameras, some of which, like the Exakta, take pictures $4\frac{1}{2} \times 6$ cm. in size ; others, like the Korelle-Reflex, give the popular $2\frac{1}{4} \times 2\frac{1}{4}$ in. negative ; and at least one, the Kine-Exakta, takes 35-mm. cine film. These, like their bigger predecessors, are adapted to take interchangeable lenses of varying focal lengths.

In the last year or two there has been a revival, in miniature form, of an old type of reflex camera—the twin-lens. This modern twin-lens reflex uses as a rule $2\frac{1}{4}$-inch roll-film and produces 12 negatives $2\frac{1}{4}$ inches square on the ordinary $2\frac{1}{4} \times 3\frac{1}{4}$ in. spool, though at least one such camera takes pictures 4 cm. square. This type of camera has two lenses of equal focal length. The upper one is used solely for focussing, while the lower lens is used for taking the picture. They are coupled together so that if your top lens shows in the reflex finder that a certain object at, say 10 feet, is sharply defined on the screen, it will be rendered with equal sharpness on the film. Instances of this type of camera are the Rolleiflex (the pioneer of this new fashion), the Ikoflex and the Voigtländer " Superb." They have become extremely popular since 1932. Unlike the mirror-reflex, these twin-lens cameras employ for taking pictures only the lens fitted originally to the camera and do not take telephoto lenses interchangeably, though for some purposes supplementary lenses may be screwed on.

In addition to these " general work " cameras there are a number of purely technical instruments and others for use by specialists, including Kodak's wide-angle camera, a finger-print camera, aerial cameras (for aeroplane work, especially survey work), stereoscopic cameras and cameras for special



VOIGTLÄNDER. The " Superb " model with two anastigmat f3.5 lenses. Taking and viewing lenses are coupled, have equal focal length, and move simultaneously

colour processes, as well as process-work cameras used in photo-engraving, and others outside the scope of this article. These are described under their own headings.

Choosing a Camera. Let us consider some of these models and the work for which they are designed, beginning with the simplest needs of an amateur photographer to whom photography is just an occasional fine-weather pastime, confined to outdoor summer snapshots. With such a bewildering array of cameras from which to choose, the beginner or the inexperienced worker may well be puzzled when he seeks to select a camera to suit his purposes.

He should first make up his mind whether he intends to be nothing more than a happy, go-as-you-please snapshotter, making exposures lightheartedly when he sees any subject that pleases him and the light is bright enough for snapshotting. Many thousands of such photographers are quite content with the most popular camera in Britain—the box-form roll-film camera using $2\frac{1}{4} \times 3\frac{1}{4}$ in. films, with a fixed focus lens and a one-speed "instantaneous" shutter. In this case the word "instantaneous" means about 1/20 second—which is good enough for snapshots of still or very slow-moving objects, but is not adequate to deal with rapid motion near to the camera.

Such cameras are produced by most big photographic manufacturers at prices ranging from 5s. to £1, and they are all good value for the money (*see* Box Camera).

A superior form of snapshotting camera is the folding type with collapsible bellows and



KODAK RETINA. A compact miniature camera fitted with exposure counter, depth-of-focus scale and other special features

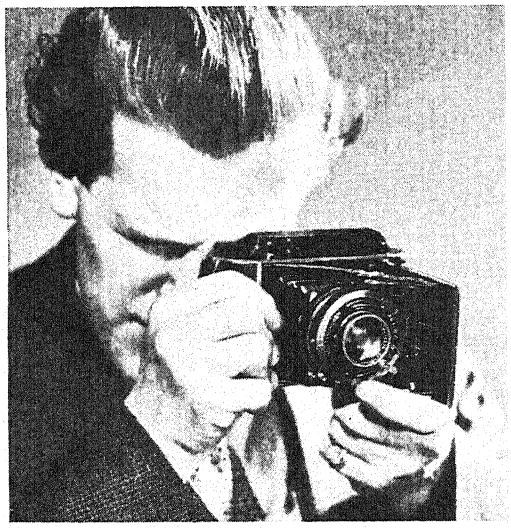


ROLLEIFLEX. The direct-vision view-finder in use; note the twin lenses, the upper being used for focussing only

with a lens of *f*11 or *f*8 and one-speed or three-speed shutter. These range in price from about 15s. or £1, according to lens and shutter equipment, up to £6 or £7, at which price you should get a high-grade lens of the anastigmat type with an aperture of *f*6 or *f*4.5, and a shutter giving a variety of speeds, including useful slow speeds such as 1 sec., ½ sec., 1/5 sec. and so on up to 1/100 sec. or 1/175 sec.

When you reach the price-range above that, you are in the region where precision work and high-grade apparatus begin, and there you find the high-quality miniature cameras with which so much fine work is being done nowadays.

If, therefore, your photography is just "general snapshotting," such as the work of nine out of ten amateur photographers, these better-class roll-film cameras will do all that you need. The best advice an old hand can give is to buy the best camera you can afford, for the size of negative that you like, and not to stint expense on the shutter. A good lens is important, but a good shutter is perhaps even more important.



CERTO CAMERA. "Super-Sport Dolly" with coupled range-finder and helical focussing device. The shutter fitted is a Compur Rapid

One remarkably simple little camera which stands in a class by itself is the Dallmeyer Snapshot camera for $2\frac{1}{4} \times 3\frac{1}{4}$ in. films, which is made in two forms—one for film-packs and the other for roll-films—at prices from three to five guineas. This camera dispenses with all complicated movements and gives you three speeds for your exposures—Fast, Slow, and Time. There are no stops with figures to puzzle the beginner, but just two positions for the diaphragm, Bright Light and Dull Light. The *f*6 lens has three focussing positions—Near, Distant, and Medium—which explain themselves. Here is a camera for the avowed novice—say the non-photographer starting on a cruise who wants a few snapshots as souvenirs of his trip and knows nothing about photographic technique or exposure problems.

The photographer who is ready to pay up to £15 or £20 for his $2\frac{1}{4} \times 3\frac{1}{4}$ in. roll-film camera with an *f*4.5 or *f*3.5 Zeiss Tessar lens or Ross Xpress fitted into a Compur shutter, has a rich choice of precision instruments. A Kodak Regent, with Zeiss *f*4.5 lens and Compur shutter and built-in range-finder to solve all his distance-judging problems for him; or a Zeiss Ikon roll-film camera, also with *f*4.5 or *f*3.8 Tessar; or a Newman and Guardia Sibyl—each is a camera that will do first-class service and be a constant joy to its owner for many years.

There is still a demand for vest-pocket-size precision cameras with much the same resources and quality, but more popular nowadays are the cameras which give you a vest-pocket-size negative by producing 16 negatives on the $2\frac{1}{4} \times 3\frac{1}{4}$ in. roll of film—that is, half $2\frac{1}{4} \times 3\frac{1}{4}$ in., a size which is almost the same as the orthodox vest-pocket size. It is cheaper, however, because you get 16 negatives on a shilling film instead of the regular eight in the strict vest-pocket size.

Miniature Cameras. Now let us look at some miniature cameras so deservedly popular. The miniature has been made practicable by the extraordinary improvement in roll-film. Twenty years ago the "serious" photographer pinned his faith to glass plates, but when the enterprise of our photographic laboratories gave us high-speed films and panchromatic films the plate users began to sit up and take notice. The Leica came—and conquered. At first the experienced photographers looked at the dainty little Leica and scoffed at it as a mere toy, but when they studied those tiny negatives of 36×24 mm. size on the despised roll-film and saw the huge enlargements of high quality that were made from them they realized that there was something to be said for the Leica and the modern roll-film by which you can snapshot such tricky subjects as a stage scene in ordinary theatre lighting and produce not just a bald "record" picture, but a real pictorial picture photographically perfect.

The individual who scornfully regarded roll-film cameras as instruments by which his friends snapshotted the baby on the lawn at midsummer and produced little contact prints saw the Leica used for snapshotting the baby in the bath at night, with high-quality enlargements as the result. He saw fine "candid photographs" of celebrities at public meetings, "first nights," and dinners and dances.

The more enlightened soon foresaw that miniature cameras of ingenious design and precision workmanship had brought a new power into photography. So it came about that both casual snapshotters and expert photographers began to use a Leica with an *f*2 lens, and a new era was opened. In ten years the miniature camera has given popular photography the greatest impetus

it has received in this generation. This growth of the Leica and Contax miniature habit has been materially helped by the addition to each camera of a range-finder built into the camera body and coupled with the focussing device which enables even a tyro to focus with unerring accuracy, and not only to use an *f*2 or *f*1.5 lens, but to use that lens at *f*2 or *f*1.5.

Candid portraits taken indoors at night at *f*1.5, theatre scenes and ballet dancing in artificial light taken on pan. roll-film at *f*1.5, are now commonplaces of up-to-date miniature work. Press photographers have gone over enthusiastically to the miniature in big numbers, and they, of all photographers, *must* get results, no matter what the difficulties.



KODAK REGENT. A roll-film camera equipped with Zeiss *f*4.5 lens, Compur shutter and built-in range-finder

The Leica did not have the field to itself for long. Several rivals appeared, and of these the Contax, a Zeiss Ikon product of very much the same type as the Leica and also with an excellent focal plane shutter, soon forged ahead. Both these delightful cameras, I firmly believe, have come to stay as a permanent feature of photography, amateur and professional.



ENSIGN MULTEX. A precision "miniature" focussing down to 21 inches

A special fact which has helped the 24 × 36 mm. miniature has been the amazing range of aids and accessories. You can have lenses of 4 inches, 5 inches, and even tele-anastigmats of 12 inches, fitted interchangeably, and a long series of varying focal lengths that fit into the mechanism of the range-finder and automatically focus the lens as you register by an accurate optical device on to the exact distance of your principal object. You can convert a Leica into a stereo camera, you can photograph objects at distances of a few inches, you can copy pages of a book—250 pages on one spool of film—in fact, one wonders where the resources of the Leica and Contax will stop. A Leica or Contax, with a caseful of their accessories, comes nearer to an all-purpose camera than any other type.



Ensign Midget

We have not yet come to the time when you can get a life-size enlargement of H.M.S. Hood from a Leica negative, but I have seen a fine lion's head study enlarged to more than life size from only a portion of a tiny Leica negative, and some equally astonishing enlargements from Contax negatives or parts of negatives.

Other types of miniatures which have entered this up-to-date class are:

The Ensign Multex, which provides 14 pictures $1\frac{1}{4} \times 1\frac{5}{8}$ in. on a vest-pocket spool. From 16 guineas.

The Certo Dollina III, which gives 36 exposures of 24 × 36 mm. film. From £17 10s.

The Super Nettel, with Zeiss Tessar *f*3.5 or *f*2.8 lens, giving 36 exposures of 24 × 36 mm. film. This is made by Zeiss Ikon, Ltd., from £18 2s. 6d.

The Robot, an ingenious automatic camera which allows a rapid-fire series of 24 pictures about

an inch square on 50-exposure spools. From £23 10s.

The Compass, an extremely compact camera with every necessary accessory built in. Price £30.

The Agfa Karat, with *f*6.3 lens, taking 12 exposures on 35-mm. film. £5 5s.

The Ensign Midget, a simple, tiny camera costing from 33s.

A miniature size which is becoming highly popular is the $2\frac{1}{4}$ inch square negative obtained on an ordinary eight-exposure spool of $2\frac{1}{4} \times 3\frac{1}{4}$ in. film. These cameras employ an automatic film counter, so that the fact that you get 11 or 12 pictures on a spool that is numbered for eight pictures presents no difficulty. An attractive camera of this type is the Zeiss Ikon Super Ikonta 530/16, which has a fine optical range-finder on the rotating wedge principle and a shutter-control device by which it is impossible to make two exposures on the same film-frame.

A good feature of this camera is its shutter release, which is placed on the top of the camera framework (as in the Leica and the Contax), instead of on the shutter itself, providing a safeguard against the risk of camera-shake.

Two other notable miniatures are the following :

Kine Exakta for 36 exposures, 36 × 24 mm., a mirror-reflex which takes interchangeable lenses. Enlarged image shown on focussing screen. From £27 10s.

Contaflex twin-lens, with built-in electric-cell exposure meter and focal plane shutter. From £64 12s. 6d.

(*See also* the special article devoted to Miniature Cameras.)



REFLEX MINIATURE. The "Kine Exakta," a single-lens reflex camera giving thirty-six exposures on 36 × 24 mm. film. Interchangeable lenses can be used

There are a number of other miniatures, such as the Kodak Retina (*see* Kodak) I and II and others from about five guineas up to £30 and more ; and also popular types of roll-film cameras which produce half vest-pocket-size negatives or half $2\frac{1}{4} \times 3\frac{1}{4}$ in. negatives on the standard eight-exposure spools. New models such as these are issued from time to time at low or moderate prices.

So far, the cameras we have discussed are for general use on subjects such as nineteen out of twenty photographers seek. But there are other subjects more specialized for which appropriate apparatus has to be sought. Here are some of these :

Architecture and Record Work. The stand camera or the folding hand-or-stand instrument is regarded as the best for these subjects. A rising front is invaluable—in fact almost essential—to the photographer of buildings, and accommodation for a wide-angle lens for work in confined surroundings is highly desirable. Much commercial work, especially photographs of machinery and interiors of buildings, is done with stand cameras in sizes from half-plate up to 12 × 10 in., or even larger sizes. Some architectural details which are sometimes needed are possible only with a stand camera possessing a large degree of rise in its front. (*See* Architectural Photography.)

Portraiture. Though some well-known professional workers use a quarter-plate reflex, or a miniature, or a Rolleiflex, in their studios, especially for child portraiture, the studio worker, as a rule, clings to his well-tried studio camera in large sizes, mounted on a solid pedestal strong enough to bear an elephant. But, then, many good portrait professional photographers prefer very long-focus lenses, perhaps of 15 or 20 inches focus, in their studios, because of the fine modelling these lenses give to the portrait ; and long-focus lenses need big, sturdy cameras.

Sports and Action Pictures. A lucky shot by a camera with a between-lens shutter may sometimes secure a good "action picture," but for sports work, action pictures and speed work a good focal plane shutter is vitally important. Press photographers use nothing else in their daily work ; they also insist on lenses of big aperture. You may not need 1/1000 sec. very often, but you will need it sometimes

in speed work. You are certain to need 1/250 sec. and 1/500 sec. often in sports work. Only a focal plane shutter can do this work successfully. The press camera with focal plane shutter scores here, so do the Leica and Contax, each of which has a first-class focal plane shutter. (*See* Action Subjects; Sports Photography.)

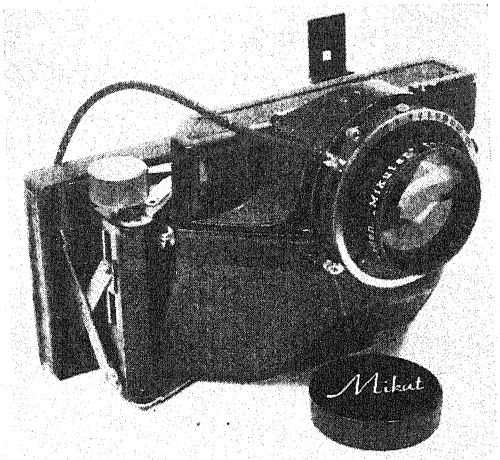
Natural History Work. For wild life and natural history photographs many types of camera are used. One expert whom I know uses a Leica with a Telyt 8-inch tele-lens for his wild bird pictures. But for the most part the naturalists I have met use a quarter-plate reflex camera with a telephoto lens of, say, 12 or 17 inches focal length and an aperture of *f*5.6. In my own Zoo work I use a 5 × 4 in. Graflex, taking film-packs and plates (more often film-packs), with an 8¼-inch *f*3.5 lens and two telephoto lenses, a 12-inch Dallon and a 17-inch Dallon. Lately, for close-up Zoo subjects, I have used a great deal a Super Ikonta giving me negatives 2¼ inches square on pan. roll-films, and I have had considerable success with a Leica and a Contax, especially in Kodachrome colour pictures with the Contax and its *f*2.8 Tessar lens.

ONE-SHOT CAMERAS FOR COLOUR PHOTOGRAPHY

Here are mentioned shortly the one-shot colour cameras in which such strides have recently been made. In conjunction with this article by Mr. J. H. Coote, see *also* Colour Photography

The taking of three colour-separation negatives at one exposure in the same camera was first patented by Du Hauron in 1862, but suitable emulsions are only of recent origin. In England at present there are about three types of colour camera in operation: the Klein, or two-reflector type; the Nectric, or semi-dialite camera; and the Mikut, which gives three separations side by side on the same plate.

The Klein camera contains two " pellicle " reflectors which partially reflect and partially transmit the light from the lens. The plates are so positioned as to give three identical images, and the reflection and transmission of the two filters is such as to ensure equal exposure of the three negatives through tricolour filters. The Klein camera is designed for 3½ × 2½ in. plates, and has an *f*4.5 Dallmeyer lens. The camera is manufactured by Bellingham & Stanley, Ltd., and marketed by Farquhar & Moloney, Conduit Street, W.1.



COLOUR CAMERA. Above is the Mikut one-shot colour camera, giving three separations side by side on the same plate

This latter firm have recently completed the first models of the Nectric one-shot, working on the popular American principle of bi-pack and one single element, with one pellicle reflector. The Nectric has the drawback of slight loss of definition of the rear element of the bi-pack combination; but, as this is the magenta printing negative and the blue-green is separate and sharp, the fact is not noticed in the finished print.

The advantage of the " bi-pack and one " type of camera is a great increase in speed over the two-reflector types, and with an *f*3.5 lens on 9 × 12 cm. negatives, exposures of 1/100 sec. can be given with the Nectric.

The Mikut system of colour photography consists of a one-shot camera and an additive projector. The beam from an *f*4 Mikatur lens is split into three by a special optical system, and three images are projected side by side through tricolour filters on to a single 15 × 5 cm. plate. A positive transparency in monochrome is made by contact and placed in the projector, when a re-combination of the positives being projected through complementary filters gives a reproduction of the original scene in full colour.

The British agents for Mikut are George H. Potts, Ltd., 7 & 9, Baker Street, London, W.1.—*J. H. COOTE.*

LIST OF MODERN CAMERAS

Maker or Agent	Name	Description	Picture Size and Stock
Actina, Ltd.	Bentzin Primarflex	Reflex for roll-film or plates	Film : 6×9 cm. Plates : 6×6 cm. or 6×4½ cm.
See Certo *and* Dollina			
	Certo Super-Sport	Plate and roll-film folding camera, with interchangeable lenses	2¼×2¼ or 2¼×1⅝
	Certix	Roll-film folding	3¼×2¼ 2½×2¼ 2¼×2¼ 2¼×1⅝
	Dolly A	Roll-film folding (also adapted for film-pack and plates)	6×4½ cm.* or 3×4 cm.
	Certotrop	Plate camera, with interchangeable lenses	3½×2½ 4¼×3¼ or 5½×3½
	Certosport	Plate camera	3½×2½ or 4½×3¼
	Dollina II and III	Precision miniature with coupled range-finder	24×36 mm. on cine film stock
	Certo Double-Box	Roll-film box camera	2¼×3¼* or 2¼×1⅝
A. Adams & Co., Ltd. ...	Minex	Reflex camera	From 3½×2½ to 6½×4¾
See Adams			
	Studio Minex	Studio camera	6½×4¾ and 8½×6½
	Verto	D.E. camera for roll-films and plates	Various
	Vaido	Universal hand-and-stand camera	"
	Vesta	Roll-films or plates	"
Agfa Photo, Ltd.	Speedex "O"	Roll-film folding	1⅝×2½
	" Compur	" "	3¼×2¼
See Agfa	" Compur Rapid	" " with fast speeds	3¼×2¼
	" Record	" "	3½×2¼
	" Clack 51	" "	1⅝×2¼
	" " 74	" "	2¼×2¼
	" Box 41	Box film camera	2½×1⅝
	Karat	Miniature roll-film folding	24×36 mm. on cine film stock
Camera Co.	Vauxhall	Roll-film folding	2¼×2¼* or 2¼×1¾
See Vauxhall			
	Vauxhall Rangefinder Minicam	Miniature roll-film camera	2¼×1¾ or 2½ square
	Vauxhall de-Luxe	Miniature roll-film camera	2¼×1¾ or 2½ square
	Vauxhall Wonder	Roll-film folding	3¼×2¼ or 2¼×1¾
Compass Cameras ...	Compass	Precision miniature plate camera (adaptable for roll-films)	1 ×1½
See Compass			
Coronet Camera Co. ...	Coronet Vogue	Roll-film folding miniature	30×50mm.
	Boy	Box camera	3¼×2½
See Coronet	Xcel	" "	2½×1⅝
	020	" "	3¼×2½
	Every Distance 8	" "	3¼×2¼* or
	" " 16	" "	2¼×1⅝ 2¼×1⅝* or
	Portrait Box	" "	3¼×2¼
	Meniscus	Roll-film folding	3¼×2¼
	Every Distance	" "	3¼×2¼
	Anastigmat f7.7	" "	3¼×2¼
	Anastigmat f6.3	" "	3¼×2¼
Dallmeyer	Speed	Focal-plane camera for plates and film-packs	3¼×2½
See Dallmeyer	Baby Speed Reflex	Reflex for plates and film-packs	2¼×1⅝
	Dual	Self-erecting folding roll-film	2¼×1⅝
Ensign	Midget	Roll-film folding vest-pocket	1¼×1⅝
	Selfix "20" and "220"	Roll-film folding	2¼×3¼ 2¼×2¼* or
	Autorange "20" and "220"	Roll-film folding with coupled range-finder...	2¼×1⅝ 2¼×3¼ 2¼×2¼* or 2¼×1⅝

* Both sizes obtainable on one camera by means of a mask

LIST OF MODERN CAMERAS—*continued*

Maker or Agent	Name	Description	Picture Size and Stock
Ensign—*cont.*	Multex II	Precision miniature with coupled range-finder	1⅝ × 1⅝
	All-distance "20"	Box camera for roll-films	2½ × 3½
See Ensign	Super-speed Cameo	Folding camera for roll-film, plates and film-packs	3½ × 2½
	"E 20"	Box camera for roll-film	2¼ × 3¼* or 2¼ × 1⅝
	Pocket "20"	Roll-film folding	2½ × 3¼
	Double "8"	Roll-film folding vest-pocket	1⅝ × 1⅝
	Zeca-flex	Folding twin-lens reflex	2½ × 2½
	Ensign-Sanderson	Hand-and-stand camera, fitted with every movement required for any pictorial subject. For plates, film-pack and cut films	4¼ × 3¼
	Ensign Reflex	Reflex camera	3½ × 2½ 4¼ × 3¼ and 9 × 12 cm.
Foth	Foth-Derby I, II	Miniature roll-film; Model II with interchangeable lenses	1⅝ × 1⅝
See Foth	Foth-Flex I and II	Twin-lens reflex	2¼ × 2¼
Gandolfi & Sons	Imperial	Taper-bellows general purpose camera	Various
See Gandolfi	Universal	Square-bellows general purpose camera	"
Wallace Heaton	Edinex	Precision miniature	24 × 36mm. on cine film stock
See Edinex			
R. F. Hunter	Rolleiflex	Twin-lens reflex	6 × 6 cm. or 4 × 4 cm.
See Rolleiflex	Rolleicord	" "	6 × 6 cm.
	Heidoscope	Stereoscopic reflex for plates or film-pack	—
	Rolleidoscope	" for roll-film	—
	Purma Special	Miniature roll-film	1¼ × 1¼
Ihagee	Kine-Exakta	Precision miniature reflex	24 × 36mm. on cine film stock
See Exakta	Exakta	" " "	1⅝ × 2½
	Multi-speed Exakta	" " "	1⅝ × 2½
	Night Exakta	" " "	1⅝ × 2½
	Auto-Ultrix	" " "	2¼ × 3¼
	Autolette	Roll-film folding	4 × 6.5 cm.
	Parvola	" "	4 × 6.5 cm.
	Pioneer	Roll-film, helical-mount extension	3½ × 2½
	Ihagee Press	D.E. camera for plates and film-pack	4¼ × 3¼ and 9 × 12 cm.
		Focal-plane camera for plates and film-pack	
Kodak	Popular Brownie	Box camera for roll-films	3¼ × 2¼
See Kodak	Six-20 Brownie Junior	" " " "	3¼ × 2¼
	" " " (Super)	" " " "	3¼ × 2¼
	" Portrait Brownie	" " " "	3¼ × 2¼
	" Brownie	" " " "	3¼ × 2¼
	Baby Brownie	" " " "	2½ × 1⅝
	Jiffy Kodak V.P.	Roll-film folding vest pocket	2½ × 1⅝
	Six-20 Folding Brownie	Roll-film folding	3¼ × 2¼
	" Kodak Junior	" "	3¼ × 2¼
	" " " de luxe	" "	3¼ × 2¼
	" Kodak	" "	3¼ × 2¼
	Six-16 Brownie	Box camera for roll-films	4¼ × 2½
	" Kodak Junior	Roll-film folding	4¼ × 2¼
	" Kodak	" "	4¼ × 2½
	Retina I	Precision miniature	1 × 1½
	Retina II	" "	1 × 1½
	Pupille	" "	1⅝ × 1¼
	Six-20 Duo Kodak	Folding roll-film miniature	2¼ × 1⅝
	Regent	Folding roll-film with coupled range-finder	3¼ × 2¼ or 2¼ × 1⅝
	Anca	Folding plate or film-pack	3½ × 2½ and 4½ × 3½
	Recomar	D.E. folding plate or film-pack	3½ × 2½ and 4½ × 3¼
Leitz	Standard Leica	Miniature precision cameras, with coupled range-finder and interchangeable lenses	24 × 36mm. on cine film stock
See Leica	Leica's II, III and IIIa		
Lon. Camera Exchange	R.M. Miniature	Folding horizontal roll-film	2¼ × 2¼
See R.M. Miniature			
Luminos, Ltd.	Noviflex	Single-lens reflex	2¼ × 2¼
See Luminos, Ltd.	Goldi	Roll-film folding miniature	1⅝ × 1⅝
Newman & Guardia	Baby Sibyl	Miniature folding, for plates, film-packs and roll-films	2¼ × 1⅝
	New Ideal	Folding camera for plates, film-packs and roll-films	4½ × 3½
See Newman & Guardia	New Special	Folding camera for plates, film-packs or roll-films	3¼ × 2¼
	Sibyl Vitesse	" " " plates and film-packs	3¼ × 2¼
	Sibyl Excelsior	" " " roll-films only	4¼ × 2¼
	N. & G. Folding Reflex	Folding reflex camera for plates and film-packs	3¼ × 2½
	"Trellis" Camera	Hand-or-stand plate camera	4½ × 3¼
Norse Trading Co.	Reflecta	Twin-lens reflex	2¼ × 2¼
	Baldax	Folding roll-film	4.5 × 6 cm.
See Baldax	Baldaxette II	Foiding roll-film with coupled range-finder	2¼ × 2¼
	Baldi	Vest-pocket roll-film camera	3 × 4 cm
	Baldina	Miniature folding roll-film	1 × 1½
	Super Baldina	Miniature folding, with coupled range-finder	1 × 1½

* Both sizes obtainable on one camera by means of a mask

LIST OF MODERN CAMERAS—*continued*

Maker or Agent	Name	Description	Picture Size and Stock
Peeling & Van Neck	Perle	Folding roll-film	4.5 × 6 cm.
	Welta-"Weltur"	Folding roll-film with coupled range-finder	3¼ × 2¼
See Peeling & Van Neck	Welta Solida	" " " " "	3¼ × 2¼
	Weltini	" " " " "	3¼ × 2¼
	Perfekta	Twin-lens folding reflex	2¼ × 2¼
	V. N. Press	Press camera	9 × 12 cm.
Photo-optics	Reflex-Korelle	Single-lens reflex	2¼ × 2¼
	Korelle K.	Miniature roll-film	24 × 18 mm.
See Korelle			on cine film stock
	Korelle P.	Collapsible camera for plates and film-packs	4.5 × 6cm.
Plaubel	Plaubel-Makina II and IIS	Folding plate camera with coupled range-finder	2¼ × 3¼
See Plaubel	Roll-op	Roll-film folding with coupled range-finder	4.5 × 6 cm.
Robot	Robot	Precision miniature with spring motor	1 × 1
			on cine film stock
Ross, Ltd.	Standard Reflex	Reflex camera	Various
See Ross, Ltd.			
A. O. Roth	Roth Superspeed	Focal-plane press camera	3¼ × 4¾
	Silar	Universal hand-or-stand camera	3½ × 2½
See Roth			to
			8½ × 6½
Sands, Hunter & Co., Ltd.	K.W. Reflex Box	Box camera with reflex focussing	3½ × 2½
	Pilot-6	Roll-film square reflex	2½ × 2½
See Sands, Hunter & Co. Ltd.	Pilot	Miniature Folding roll-film reflex	1⅝ × 1⅝
	Patent Etui	Single or double extension folding camera for plates, roll-film and film-pack	3½ × 2½
			and
			4¼ × 3¼
R. E. Schneider	Altiflex	Twin-Lens reflex	2¼ × 2¼
See R. E. Schneider			
Sheffield Photo Co., Ltd.	Norfolk Miniature	Roll-film folding	4½ × 6 cm.
	Norfolk Roll-Film	" "	3¼ × 2¼
See Norfolk Cameras			and
			1⅝ × 2¼
	Norfolk Plate	D.E. camera for plates, film-pack or roll-films	3½ × 2½
James A. Sinclair & Co., Ltd.	Traveller Una	Metal hand-and-stand camera. D.E.	3½ × 2½
	Standard Una	D.E. hand-and-stand camera	3½ × 2½
See Sinclair			to
	Wide-angle Una	D.E. hand-and-stand camera with back-racking movement	7 × 5
			3½ × 2½
			to
	Technical	Square bellows, long-focus stand camera	7 × 5
			6½ × 4¾
			to
Soho	Cadet	Folding roll-film camera	15 × 12
	Tuon	" " "	3¼ × 2¼
See Soho	Altrex and Celtrex	" " "	2½ × 1⅝
			3¼ × 2¼
	Soho Reflex	Plate reflex camera	4¼ × 2½
			From
			1¾ × 2⅜
			to
	Baby Soho	Reflex for plates or film-packs	6½ × 4¾
	Stereoscopic Reflex	Stereoscopic camera	2 5/10 × 1⅝
	Dualex	Focal-plane press camera	5½ × 3½
	Roll-film Focal-plane	Focal-plane camera for roll-films	5 × 4
	Soho Press	Focal-plane press camera	4¼ × 3¼
			3½ × 2½
			4¼ × 3¼
			and
	Studio Cameras		5 × 4
Thornton-Pickard	Detective	For copying finger-prints, signatures, etc.	Various
	Rubyette Reflex	Reflex camera (plates, film-pack or roll-film)	3¼ × 2¼
See Thornton-Pickard			3¼ × 2¼
			and
	Ruby Horizontal	" " " " "	3¼ × 3¼
	Junior Special Ruby	" " " " "	3½ × 2½
	Special Ruby	" " " " "	Various
	Ruby de Luxe	" " " " "	"
	Duplex D.E. Reflex	Double extension reflex camera for plates, film-pack or roll-film	"
	All-weather Press	Focal-plane press camera	4¼ × 3¼
	Imperial	Triple-extension stand camera	Various
	Royal Ruby	" " "	"
Voigtländer	Brilliant	Reflex-finder box camera	2¼ × 2¼
	Bessa	Folding roll-film camera	2¼ × 3¼
See Voigtländer			or
	Range-finder Bessa	Folding roll-film camera with coupled range-finder	2¼ × 1⅝
			2¼ × 3¼
			or
			2¼ × 1⅝
	Superb	Twin-lens reflex	2¼ × 2¼
W. Watson & Sons, Ltd.	Alpha	Hand-and-stand, with dropping base for wide-angle work	Various
See Watson	Acme	Compact bellows camera	"
	Premier	Square-bellows technical camera	"
	Sayce-Watson Technical Camera	Miniature Scientific camera	24 × 36mm.
			on cine film stock
Zeiss Ikon	Box Tengor	Roll-film box camera	1⅝ × 1¼
			to
			4¼ × 2½

LIST OF MODERN CAMERAS—*continued*

Maker or Agent	Name	Description	Picture Size and Stock
Zeiss Ikon—*cont.*	Nettar series	Roll-film folding cameras...	$2\frac{1}{4} \times 1\frac{3}{4}$ and $3\frac{1}{4} \times 2\frac{1}{4}$
See Contax *and* Zeiss Ikon	Ikonta series	" " "	$1\frac{5}{8} \times 1\frac{1}{4}$ to $4\frac{1}{2} \times 2\frac{1}{2}$
	Super Ikonta series	Roll-film folding with coupled range-finder	$2\frac{1}{4} \times 1\frac{3}{4}$ to $4\frac{1}{4} \times 2\frac{1}{2}$
	Icarette	D.E. roll-film folding adaptable for film-packs and plates	$3\frac{1}{2} \times 2\frac{1}{2}$ and $2\frac{1}{4} \times 1\frac{3}{4}$
	Ikoflex I and II	Twin-lens reflex	$2\frac{1}{4} \times 2\frac{1}{4}$
	Super Nettel	Precision miniature with coupled range-finder	24×36 mm. on cine film stock
	Nettax	Precision miniature with coupled range-finder and interchangeable lenses	"
	Contax series	Precision miniatures with coupled range-finder and interchangeable lenses. Built-in photo-electric exposure meter in model III	"
	Contaflex	Precision miniature reflex, coupled range-finder, interchangeable lenses and electric exposure meter	"
	Maximar	D.E. folding for plates and film-packs	6×4 $4\frac{1}{4} \times 3\frac{1}{4}$ and $3\frac{1}{2} \times 2\frac{1}{2}$
	Ideal	" " " " " "	$3\frac{1}{2} \times 2\frac{1}{2}$ and $4\frac{1}{2} \times 3\frac{1}{4}$
	Trona	" " " " " "	$3\frac{1}{2} \times 2\frac{1}{2}$ and $3\frac{1}{4} \times 4\frac{1}{4}$
	Nettel	Focal-plane camera for plates and film-packs	$4\frac{1}{4} \times 3\frac{1}{4}$

CARE OF THE CAMERA: PRACTICAL HINTS

Here are given some welcome practical tips for the remedying of the many small defects and dilapidations that may occur in a camera after long use—from the removal of dust to the lubrication of dark slides

Too often after good results at the commencement of one's photographic career there is a decided falling away in the quality of one's pictures, and one begins to feel that one has lost the "knack" of taking good pictures. When such a state of things occurs one must realize that just as a motor-car or cycle needs a periodical overhaul, so does the camera. Half the secret of taking good pictures is keeping the camera in good condition.

Although a camera must be light-excluding, it has not yet been possible to design one which is proof against dust. At the beginning of each year a thorough dusting out of the interior must be undertaken, especially with due regard to the folds of the bellows. The back of the camera should be removed, the front should be extended as far as possible, and dusting done with a stiff brush. The camera should be so held that any dust dislodged will fall out of the instrument. The spool-chambers or plate-holders must not be forgotten.

If the camera is a very small one hold it with the back removed, open end downwards, while a football inflater, motor pump, vacuum cleaner, or similar apparatus is operated.

If the instrument is a plate camera, the slides are probably the dwelling-place of quite a lot of dust, as a certain amount is sometimes rubbed off the edges of the plate.

To test for light-tightness take off the back of the camera, put a large lightproof cloth over the back of your head, and then arrange it so that it fits over the back of the camera on to your head. Then look for the faintest gleam, the slightest glimmer in the darkness that surrounds you. Even if the bellows joints pass the test, you may be surprised to find that several small holes are visible in the bellows themselves, particularly in the corners. These can be filled up with a little rubber solution thickened with a little lamp-black powder, or covered with small pieces of black court plaster.

Another method of doing this test, and an even more thorough one, is to make use of a small 4-volt lamp. It is easy to fix this in a small holder and connect up with a pocket-lamp battery. Then turn out the light in the room and put the lamp into the film or plate end of the camera, and holes will soon show if present. Then close that end of the camera with a plate-holder and

take out the lens and, if the hole is large enough, insert the lamp in this end—it is usually possible to take off the shutter if the lens aperture is not big enough—and then have a good look to see if the back of the camera is quite light-tight.

The pile of the velvet or plush used for light-traps of dark slides may wear thin. These are strips of ribbon velvet such as are sold by all large drapers. This is easily attached with liquid glue, but care must be taken not to apply too much of the adhesive or to allow it to get into contact with the pile of the velvet. There is sometimes a difficulty in getting the velvet to adhere to metal. In this case it is a good plan to affix first thin paper or linen to the metal surface. The cement will attach the velvet to the latter without trouble. If the velvet has become flattened it can be raised by projecting the steam from a boiling kettle on it.

It is also important to give some attention to the plate-holders. The draw-out shutters should work smoothly; if they are stiff a trace of oil at the edges will work wonders. If the enamel has become chipped, or the metal rusty, the latter may be cleaned off and a coat of cycle enamel applied. Wooden dark slide shutters can be lubricated with a mixture of oil and graphite.

The rollers of the roll-film adapter, and also of roll-film cameras, should be tested for roughness, which is responsible for lines and markings on the film. If the roughness exists it should be rubbed down with the finest emery-paper.

Focussing Scales and Shutters

Register is a very important thing, and also the correctness of the focussing scale. There is no better time to test both of these things than when overhauling. It can be done with the focussing screen and a well-defined object—a white poster with large printed letters is an excellent thing. This is set up at measured distances from the camera, and the focussing-scale reading is compared with the measured distance. In the case of roll-film cameras which do not possess a focussing screen, a temporary one consisting of a piece of greaseproof or tracing paper stretched across the back.

With the exception of the most simple shutters, any repair or adjustment is beyond the skill of the amateur. The only course is to send the instrument to a competent repairer.

Damp weather often affects shutters, making them stiff, when first they are used; with a little exercise this stiffness will wear off.

Oil should never be used on any account, as it will usually make things worse.

If the shutter is of the focal-plane type it should be inspected for small holes. Should any be found, the rubber solution mentioned previously will often stop them up, but a new blind is in the end the most economical.

Various methods of shutter testing have been advocated (*see* Shutter), but if the owner of a doubtful one insists on having an absolutely accurate test, it should be sent to the National Physical Laboratory.

Care of the Delicate Lens

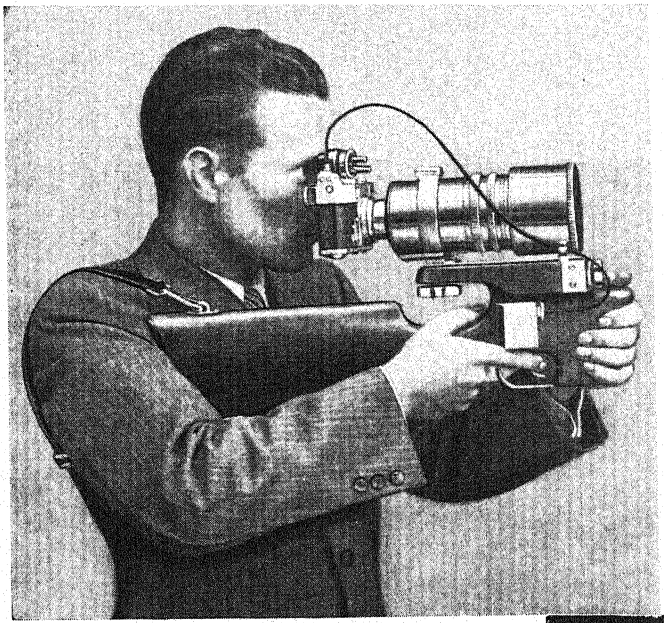
The less cleaning that a lens is subjected to the better. All that should be necessary is a gentle wipe with chamois leather or the softest of linen handkerchiefs. Anything in the nature of vigorous polishing must be avoided.

The finest performance of many an excellent lens has been spoiled through attempts at cleaning.

If the lens is of the R.R. or anastigmat type, uncemented and easily unscrewed, the cells should be removed and the glasses cleaned. If the lens is of the anastigmat type consisting of several components of different position, it is necessary to exercise great care in order to see that the elements are reinserted in the right sequence.

Cleaning should be done by first of all brushing the surface with a camel hair brush to remove grit, and then gently wiping the glass with a sponge moistened with spirit or eau-de-Cologne. Care should be taken not to use too much, or it may get into the cement of the lenses and cause discoloration. It is important to clean round the edge of the lens near the mount. Finally, the surface is gently polished with a chamois leather. Filters and supplementary lenses should be similarly treated. Failing the lens-cleaning outfit, breathing on the surfaces of the glasses and polishing gently with an old soft and well-washed cambric handkerchief will help to keep the lens clean. Proprietary lens-cleaning fluids are also marketed, such as "Summol."

CAMERA GUN. This accessory, as distinct from the type of camera used in aircraft-gunner training described below, was developed in 1936 for use at the Olympic Games, held in Berlin in that year. Its design was necessitated by the introduction of a Zeiss lens of $7\frac{1}{8}$ inches focal length, and of very great aperture, *f*2.8, which was intended to be used in conjunction with a miniature camera. As the outfit had to be easily portable and yet rigid in use, owing to the long focal length of the lens, some form of support had to be devised. This support is shown in the illustration, and is really a specially adapted rifle stock, with the lens as an imaginary barrel and the sighting system arranged to come conveniently close to the eye. The trigger is connected by means of an antinous cable to the camera release. This apparatus has since found favour with big-game hunters and others as a telephoto outfit.



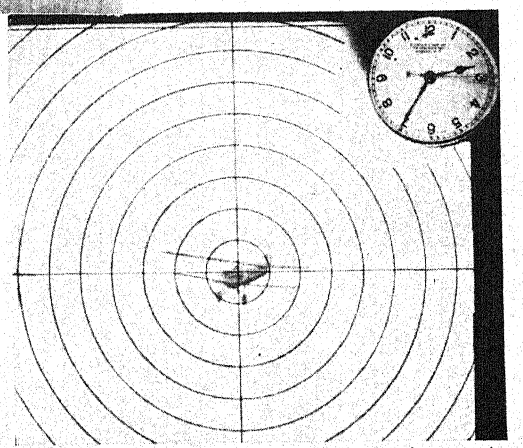
SHOOTING WITH THE CAMERA. The camera gun seen above is specially designed for taking long-range action pictures. It comprises a miniature camera fitted with a Zeiss *f*2.8 lens ($7\frac{1}{4}$ in. focal length), the whole being mounted on a form of rifle stock. The latter is used to give the rigidity made necessary by the weight of the lens and to provide the requisite portability

The aircraft camera gun is a British invention which was evolved during the Great War with the object of improving the training of air pilots and observers in the art of aerial gunnery by producing photographic records of the effect of the firing.

The first camera gun was known as the "Hythe," and it was designed so that it was outwardly almost a replica of the Lewis machine-gun. It had, for instance, a barrel casing of the same dimensions as those of the Lewis, a spade grip, cocking handle, magazine and trigger.

Within the barrel casing was mounted the shutter and the lens. At the rear end of the barrel casing a film box was arranged, and between it and the lens a glass screen was interposed. This screen was scribed with lines and concentric circles. The cocking handle was connected to the film-spool-carrying mechanism, so that its action changed the film after each exposure. The shutter was operated by the trigger, but, until the cocking handle was set, no exposure was possible. In this way all the movements necessary to fire the Lewis gun had to be carried out in operating the camera gun.

The latest type of camera gun is known as the Williamson G.22. A special telephoto lens of 12 inches focal length is adopted, and this is used in conjunction with a patent louvre shutter. The body of the camera is made of aluminous alloy, and separate compartments are provided inside the main casting for the lens,



PROOF OF MARKSMANSHIP. A photograph taken with an aircraft camera gun. By the position of the image of the "hostile" machine within the concentric rings the gunner's aim is checked. The clock-face records the time of action

shutter and film-holder. Incorporated with general assembly is a watch which automatically records on the negative the duration of the " burst of fire." The G.22 takes standard film $2\frac{1}{2}$ inches wide, and the spools allow from 10 to 16 exposures to be made. A development of the camera gun is the Williamson cine gun camera. This camera, which is motor-driven, is considered to be an improvement upon the single-picture camera gun, in that a complete and continuous record is obtainable of an aerial combat. The casing of this camera is bakelite, and it is streamlined to reduce air resistance. The lens fitted is a 2-inch Dallmeyer *f*3.5, and a 16-mm. film is used.

"CANDID" PHOTOGRAPHY: A MODERN INNOVATION

W. R. Ayling, A.I.P.A., A.R.P.S.

Though mainly used by newspaper photographers for the minor purpose of " snapping " celebrities at restaurant tables, point-to-point meetings and other places where they are unaware of the camera's presence, " candid " portraiture is by now an established variety of photography, and merits the serious consideration given to it here

See also Child Photography; Portraiture, etc.

CANDID photography can best be described as the unobserved, intimate snapshotting of people at work, at play or during rest. A picture of a man eating his lunch or of his mother asleep in a deckchair can both equally well be covered by the term " candid."

In this type of work I have personally found the miniature camera most essential, using a Leica with its short-focus lens and wide aperture. The focal length of the Summar *f*2 enables the user to set the focus approximately beforehand, if necessary, and to proceed to take his pictures. The depth of focus, clearly indicated on most miniature cameras, gives a very fair idea of the field within which the person to be photographed may safely move without the user of the camera having need to alter the focus of his lens.

The large-aperture lenses, available in compact form, in miniature camera work, render transport and handling of the apparatus an easy matter. In addition, the miniature camera is more easily concealed than its larger and heavier contemporary. This is rather an important point, because the most charming and interesting pictures are frequently taken when the person being photographed is unaware of the fact. A reflex view-finder, in addition to the direct optical finder, is often a great advantage.

My camera, when used for candid photography, is fitted with the extra reflex finder, clipped to the top. The lens is fitted with a deep hood which eliminates the tendency to flare, caused by the proximity of lights when working indoors, and enables me to get against-the-light shots outdoors.

For candid work the operator should have an eye quick to grasp favourable opportunities, as the camera must be brought to the ready at a moment's notice. A steady hand and a light but firm grip of the camera must be cultivated, as exposures sometimes require 1/5 or 1/10 second—long enough to make " camera shake " a real risk.

The most suitable negative material is undoubtedly medium fast panchromatic film such as the following:

Kodak SS Pan. Speed: sch. 26°. Weston 24 to daylight, 12 to artificial (Mazda) light.
Agfa Isopan ISS. Speed: sch. 30°. Weston 24; and others in the same speed class.

For work under poor lighting conditions:

Kodak Super X. Speed: sch. 29°. Weston 32. Afga Isopan ISS. Speed as above,

may be safely used and, if known to be under-exposed, may be stretched in development and intensified quite successfully.

Where conditions do not require such a fast film, *i.e.* outdoors in good light:

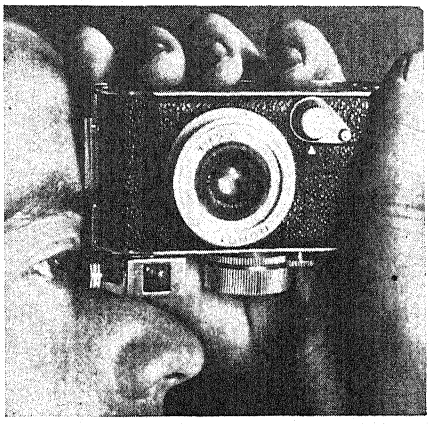
Kodak Panatomic Film. Speed: sch. 17° to 20°. Weston 16 to daylight, 8 to artificial (Mazda) light.
Agfa Isopan F. Speed: sch. 27°. Weston 20.
Agfa Isopan FF. Speed: sch. 20°. Weston 12,

or other films of the same speed rating.

If time permits, it is always advantageous to measure the light which is reflected from the subject by means of an exposure meter. This is particularly essential in the case of indoor exposures made by artificial light.

In most cases it will be known beforehand when candid photographs are to be taken,

and I would suggest that the user of the camera should measure the light either before his subject appears on the scene or whilst he is preparing his camera. Measuring the light with an exposure meter can be done quietly and unobtrusively, a photo-electric cell being best for the purpose. In the majority of cases it will not be necessary to use a filter unless particularly good pictorial effects are aimed at.

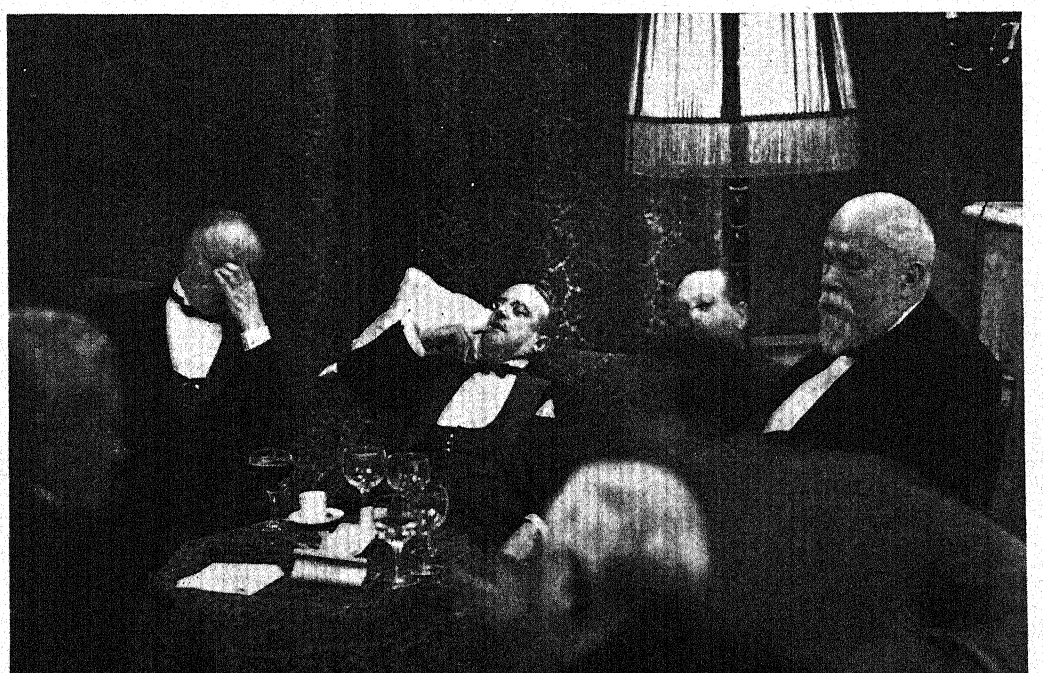


ANGLE-FINDER FOR CANDID SNAPSHOTS Above is seen an angle-finder in use on the Robot camera, with lens towards the right; the camera is held upside down. By supporting the left thumb on the nose and the forefinger on the forehead, the alinement of the angle-finder and the right eye is maintained

With regard to the method of holding the camera, I have found it easy to use a neck-strap, the ends of which are clipped to the side of the camera, and for which most miniature cameras are fitted with metal loops. If this neck-strap is adjusted so that the camera lies on the chest, a slight pull can be exerted downwards against the strap, and a favourable moment chosen, when the lungs are fully inflated, to press the button. This method is, of course, only applicable when using the reflex view-finder or when using one of the miniature reflex cameras. When using the direct form of view-finder some method of supporting the elbows on a chair or wall, or even leaning against a firm upright of a building, is to be preferred to just balancing on the feet.

These cautionary instructions apply only in the case of the longer exposures, from about 1/5 to 1/20 of a second. From 1/30 onwards the average user should have no difficulty in maintaining a steady grip of his camera.

In the case of indoor functions, dinners, banquets and speechmaking, beware of obstructions. It may be that a bowl of flowers or other table decorations may obstruct your vision and be so near to you



CONFERENCE AT EASE. This supreme example of "candid" photography shows the end of the night conference of the German and French ministers during the Second Hague Conference in January, 1930

Photo, Dr. Erich Salomon

that you do not realize the obstruction they cause. Also remember that large dishes and cutlery will reflect light and cause flashes into the lens. A quick glimpse around you, just prior to making the exposure, will enable you to spot anything of this nature which is likely to spoil your picture.

In the case of photography at banquets, be careful that your victim is not in the act of taking a large mouthful, otherwise the results will not be as pleasant as if the "sitter" were smiling happily.

Development of films or plates should be carried out with one of the standard fine-grain developers, because pictures of this nature are usually enlarged to a considerable extent. Kodak D76 or Ultra Fine Grain Developer, Agfa "Atomal," or "Tetenal" developer do not require extra exposures, and are suitable for developing "candid" films.

The usual fault in connexion with candid photography is under-exposure, for which the obvious remedy is to expose more fully or, if this is impossible, to treat the finished negative by bleaching and intensifying. You cannot, however, expect to put on your negative subject matter which has not registered at all (*see* Intensification).

Another fault, customary in candid work, is movement, either of the camera or of the subject being photographed. The remedy for the first is to find some easy manner of holding the camera steady. (It is surprising how a little movement of the camera will spoil a good picture.) The remedy for the second is to make more shots. In the case of miniature cameras, many shots can be taken at low cost, and 20 or 30 exposures are worth while in order to secure one or two clear, excellent pictures of the subject.

Using the Angle-Finder

For candid camera work, you should cultivate an easy, firm method of holding your camera and practise it constantly. Try taking pictures at right angles by using a right-angle view-finder, or even the customary reflex finder, holding the camera on its side. Most reflex cameras can be used upside down or even sideways for this purpose.

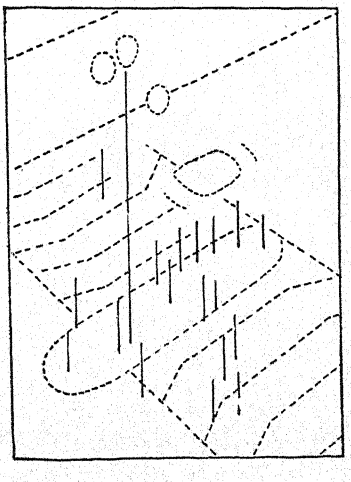
The average amateur should experience no difficulty in practising candid photography, provided full exposures are given, a careful choice of the best negatives is made, and opportunity keenly watched.

CAP. The cover which is used, chiefly on studio cameras, to uncover and close the lens when making a time exposure.

A cap is also provided with all cameras having delicate and expensive lenses to protect them from dirt and accidental damage. To prevent the cap being mislaid it is attached to the lens mount either by a black silk cord or by a hinge.

Orange glass lens caps are fitted to projection printers to allow the bromide paper to be placed in position on the baseboard or easel without fogging.

Notes on Composition of "THE CROSSING"



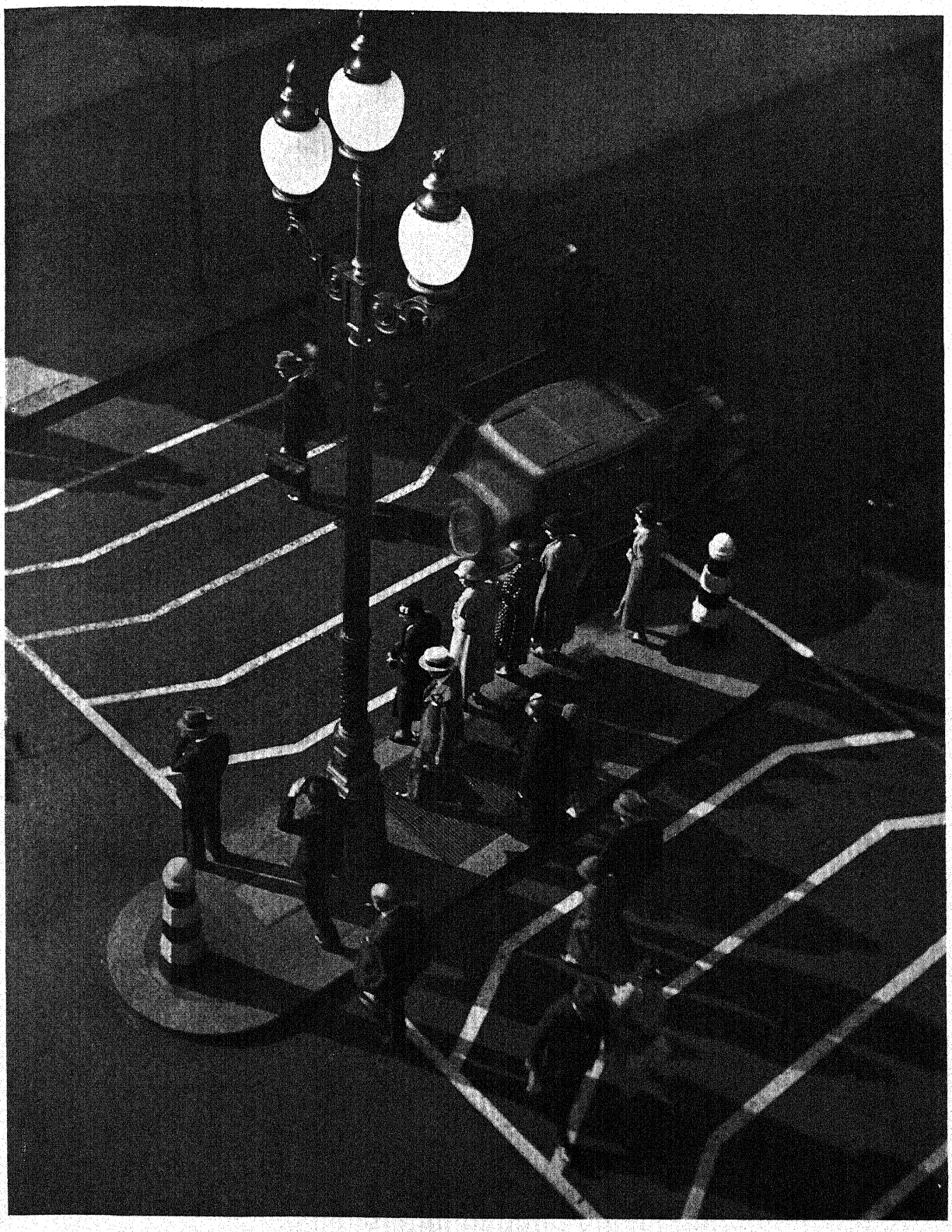
Long before the idea of the "new angle" picture had become somewhat overworked, the author of this example attracted attention by the ability with which he presented such subjects. He showed that he was able to deal with them without conveying a suggestion of eccentricity or an impression of instability in the composition.

Here the subject matter is familiar, but indicates originality of outlook. The viewpoint is not the most usual one, but is easily comprehensible as the effect that would be seen from a window not too high up. There is no over-straining of the perspective, and the verticals are so true as to suggest the probability of a falling front being brought into operation.

In the diagrammatic sketch the composition has been simplified into a few salient lines of direction, and this helps to emphasize the reason for the obvious static effect the picture produces. There is a pronounced repetition of verticals, the strong line of the lamp-post being repeated by the many verticals of the figures. Although the three brilliant globes attract attention, the eye easily runs down to the group of figures, which are roughly contained in a triangular space. The diagonal band of the crossing is opposed by strong angular lines at right angles to it.

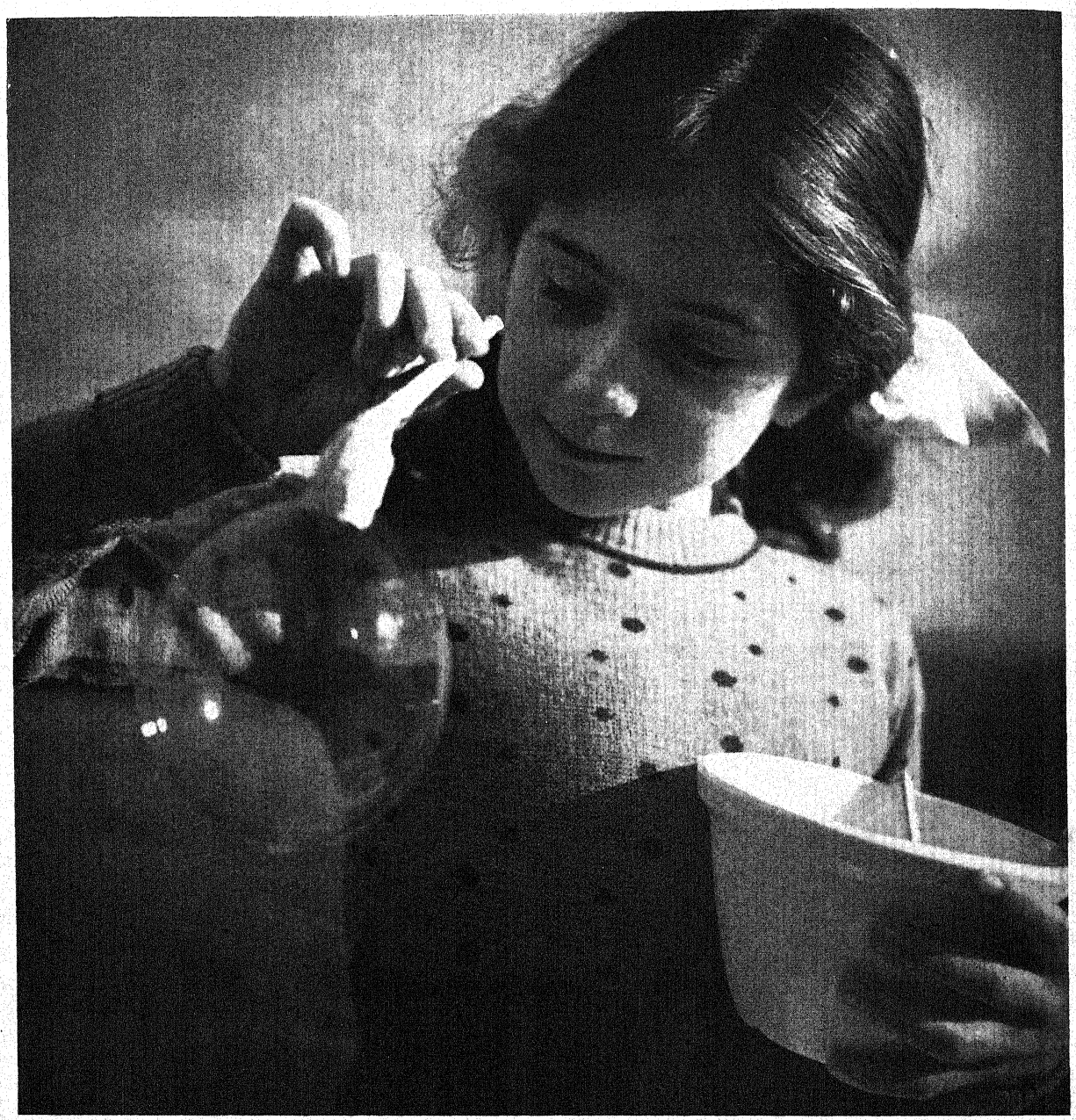
A low light gives sparkle to the figures, while the long-cast shadows bind the group well together. The suggestion of the moving car explains the general arrested motion. It is a firmly knit composition.

W. L. F. W.



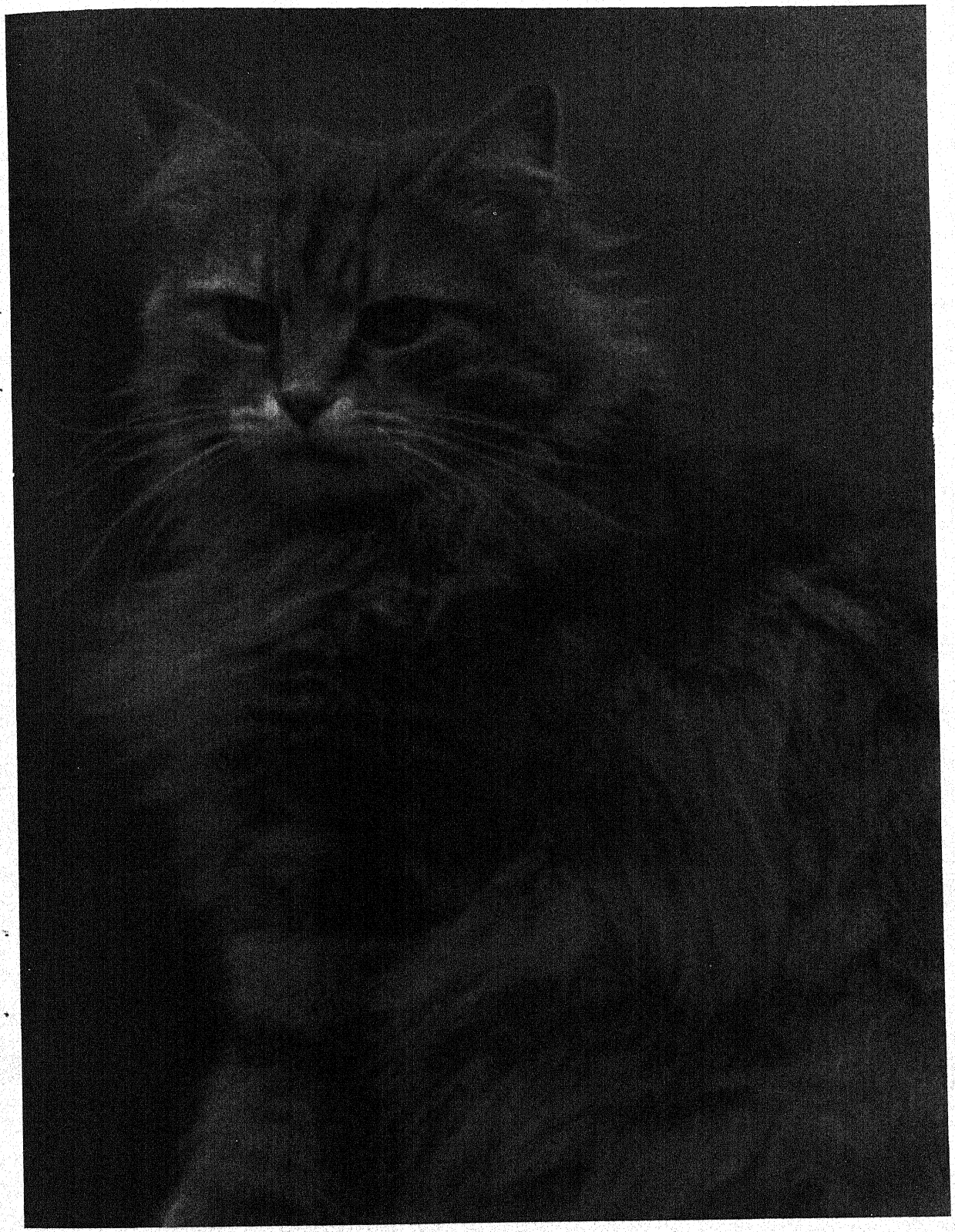
'THE CROSSING' — John Ahern, F.R.P.S.

Soho quarter-plate reflex camera, 1/75 sec., f5.6, Verichrome film pack



SOAP-BUBBLES

1/75 sec., f6.3, K2 filter, Kodak Panatomic film. A pleasing example of Child Photography (see pp. 272–284). Copyright, Kodak, Ltd



'ALEXANDER' Miss D. E. Layard

T.P. Reflex camera, Dallmeyer telephoto Dallon 12-in. lens, 1/25 sec., f5.6, Verichrome film pack. (See article on Cat Photography, pp. 257–264)



OLD COTTAGE AT BIGNOR, SUSSEX B. Chambers, F.R.P.S.

Fine example of the Carbro process, obtained from a bromide print (see article, Carbro, pp. 248–252)

CARBON PROCESS FOR CONTACT PRINTING

B. Chambers, F.R.P.S.

Of the Autotype Co., Ltd.

The idea is unfortunately prevalent amongst amateur photographers that the Carbon process is unusually difficult and complicated. That this idea is erroneous is shown in the following article, which explains lucidly how the superb results possible by this process may be obtained with little more trouble than prints made by most other media. Carbon is essentially a contact process. For enlargements see Carbro

THE carbon print, though requiring more time to produce than prints made by most other media, has great advantages and qualities, and the superb results obtained well repay the extra time taken.

Probably the greatest appeal of the process to the average worker is the great variety of results obtainable. Whereas in most of the other printing media available only one colour, with perhaps slight variations of tone, is possible, the carbon worker has enormous scope on account of the large number of pigment papers of various colours and the equally large selection of support papers.

A seascape or woodland scene, printed in one of the several greens available, will often reveal qualities hitherto unsuspected in the negative, while the mellow soft tones of ancient woodwork or masonry may be beautifully rendered in brown or black.

As regards quality, carbon still holds a premier position. The image is composed of pure pigment in gelatine, which gives a brilliancy and richness of truly remarkable quality. The results are absolutely permanent, and extremes of temperature or climate have no detrimental effect.

Carbon printing is not difficult, and given a negative of the requisite quality, a most important point, and the exercise of care in manipulation at the various stages, no undue difficulty should be experienced.

Origins of the Process

The basis of all the processes to which reference will be made is the action of light upon organic matter in the presence of the alkaline bichromates. Mungo Ponton first observed this action when exposing to light paper which had been immersed in a solution of bichromate of potash. Becquerel showed that sized paper acted much more rapidly under such action than unsized paper; hence the association of gelatine or gum, or their analogues, with the bichromates in such experiments.

Poitevin found that if a pigment were mixed with the compound of gelatine and bichromate, those portions upon which the light acted were rendered wholly or partly insoluble. On putting his exposed pigmented paper in warm water, however, he found the pigmented compound floated away from the paper altogether, but he also found that if he spread his pigmented gelatine very thinly, and exposed it to light under a negative with pure black and white lines, he was then able to dissolve away only those portions upon which the light had not acted, and he actually so produced the first photograph in pigment.

Swan's Improvements

The late Sir Joseph Wilson Swan introduced the first practical method of pigment printing in 1864. He coated glass with pigmented gelatine, but first coated it with collodion; when the whole was dry it was stripped from the glass and thus was made the first autotype pigment paper.

Later, he did away with the collodion and glass, and simply spread his pigmented gelatine on paper. This was exposed to the action of light under a negative; the surface was then coated with indiarubber solution, forced into contact with a piece of paper similarly coated. The adherent sheets were then placed in warm water, which softened the gelatine in contact with the paper upon which it was first spread, enabling that to be skinned off. The picture was washed up from the back, rinsed in cold water, allowed to dry, and there was the photograph complete, resting on the indiarubber paper. But it was reversed. To obviate this, paper was prepared with gelatine,

rendered practically insoluble by means of alum; this being placed in warm water the gelatine became softened. The photograph on the indiarubber paper was then put into contact with this gelatine paper under water and the two surfaces brought together. When dry, the indiarubber paper was removed, revealing the print in its proper position, attached to the gelatine paper.

Carbon Prints 70 Years Ago

In 1868, Mr. J. R. Johnson found that in order to fix a pigment print upon a permanent or temporary support no cement was necessary, provided that the support was impervious to air and water; that if we simply lay the wetted tissue upon such a support, removing the air and excess of water from between the surfaces, the insoluble or partially insoluble surface of the tissue adheres to it. The tissue, thus mounted on an impermeable support, was placed in warm water which, softening the gelatine at the back, enabled the paper to be skinned off and the picture developed.

If glass is used as the support, the picture is complete as a transparency, or as a picture to be viewed by reflected light when backed with paper. If the support is not transparent, the picture is inverted if ordinary negatives have been employed.

The Temporary Support

In 1874 Mr. J. R. Sawyer introduced his "Flexible Temporary Support," which, by permitting the development of the picture on a soft couch or film of an insoluble colloid body, secured perfect adhesion.

The temporary support consists of a tough and hard paper specially made for the purpose, and coated very evenly by machinery with a solution of gelatine which, when dry, is perfectly insoluble. This is again coated with an alkaline solution of lac, and the surface is next treated with a waxing compound which enables the picture to be easily stripped from the support on the application of the transfer paper. The advantages of this support are numerous. It enables the picture to be viewed perfectly during the process of development; the yielding nature of the surface holds without blurring the delicate detail of the image. The pieces of support can be used over and over again almost indefinitely.

Such were the various stages by which the Autotype carbon method of producing photographs has reached its present development. The process has passed through the early stages of difficulty and uncertainty to establish success, owing to a more complete understanding of principles, to simplification of procedure and to great improvements in the manufacture of materials. Unlike photographs produced in silver compounds, the carbon print is as durable as the pigment employed in its production. If this is permanent, so is the print, for it owes its colour entirely to this inert pigment in its unchanged condition.

The material employed for prints in permanent pigments is known as Autotype pigment paper or, as it is very commonly called, carbon tissue, and one of the very great advantages that this process possesses, besides permanency of results, is the variety of colours in which the pigment papers are obtainable; there being, in fact, a range of about 30 different colours.

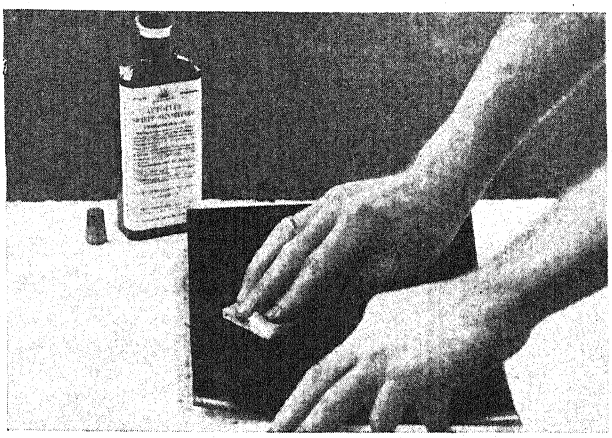
Single and Double Transfer

There are two methods of producing carbon prints: single transfer and double transfer. If prints are made from ordinary glass negatives the image in the finished print is reversed if made by the single-transfer method. As the image, which is in correct position on the pigment paper, becomes reversed in the process of transferring, to correct this reversal the double-transfer method is employed; that is, the image is developed upon a piece of temporary-support paper and then transferred to a final-support paper, which will bring the image the right way round. The various flat films and spools of films now in common use may be quite successfully printed by the single-transfer method by reversing the film in the printing frame.

When making glass negatives specially for carbon printing, the usual method is to reverse the plate in the plate-holder by placing the glass side nearest to the lens and, of course, making the necessary adjustment to the focussing screen. This will give a correctly placed image when printed by the single-transfer method.

The first step necessary in the production of a carbon print is the sensitizing of the pigment paper. Some pure bichromate of potash is dissolved in hot water. One ounce of bichromate to each pint of hot water will give, approximately, a 5 per cent. bath, which is a convenient standard for dilution as required.

A 4 per cent. bath is about correct for normally dense negatives, but a weaker bath may be advantageously employed for weak negatives. It must be remembered that the strength of the sensitizing bath affects the printing speed of the paper; for instance, pigment paper sensitized in a 1 per cent. solution requires about three times more exposure than a piece treated in a 4 per cent. solution and printed from the same negative.



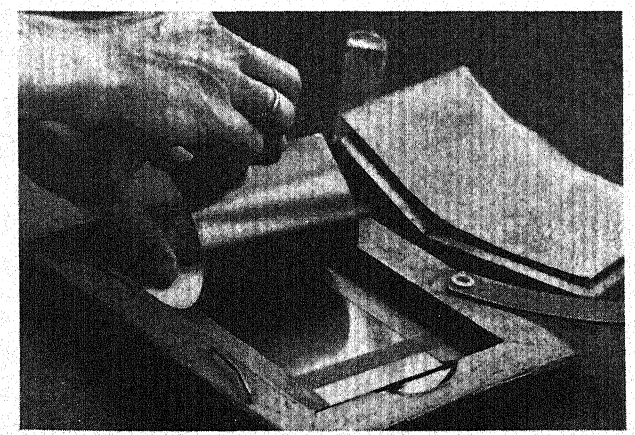
SENSITIZING THE PIGMENT PAPER. As explained in the text, this is done with a bichromate bath; but in the illustration above the operator is using, for quickness, a spirit sensitizer, which is applied to the surface of the tissue with a piece of soft flannel, with firm, even strokes each way

A piece of pigment paper slightly larger than the negative to be printed is placed in the above bath, which must be cold. The paper should be thoroughly immersed, any air-bells should be removed, and the edges of the pigment paper should not be allowed to come above the surface of the solution.

Two minutes' immersion will usually be found sufficient to allow the pigment paper to absorb enough solution. It will then lie quite limp and flat in the bath. The saturated pigment paper is then removed and laid face downwards on a sheet of glass and any superfluous solution removed with a flat squeegee. It is then stripped off the glass and hung up by one corner to dry in complete darkness. The sensitizing should preferably be done in artificial light, but if done in daylight great care must be exercised to see that it is very subdued.

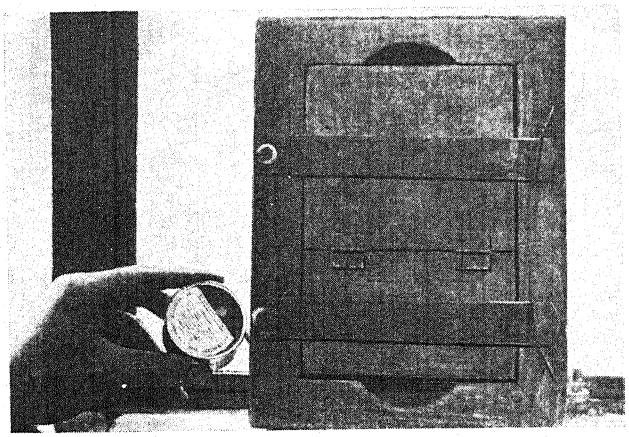
When dry the pigment paper is highly susceptible to the action of daylight, and unless kept in special storage boxes it will not keep in good working condition for more than a few days. For the quick sensitizing and drying of pigment paper a spirit sensitizer is available, but the method described above is preferable.

Prior to printing, the negative must be provided with what is known as a safe edge—an opaque margin all the way round. This can best be done by cutting a paper mask. The object of this safe edge is to give a soluble margin all round the picture, failing which trouble would probably be experienced at a later stage of the proceedings. The negative is then placed in the printing frame in the ordinary way, and a piece of the sensitized pigment paper, slightly larger than the masked image, is next placed in contact with it.



THE PRINTING FRAME. When dry after sensitizing, the carbon tissue is placed behind a negative in a printing frame. Note the safe edge on the negative formed by strips of gummed tape

Printing is carried out in daylight, but not in direct sunlight, and as no visible image is formed during the printing stage the



PRINTING BY DAYLIGHT. The loaded printing frame is next exposed in a window, but not in direct sunlight. The exposure must be timed with an actinometer of the type shown turned, of course, to the window

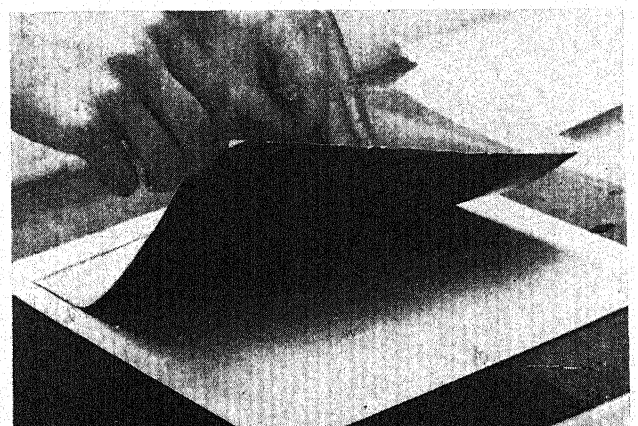
exposure is determined by means of an actinometer (*see* Exposure Meters). These may be obtained in several forms, but the principle of working is the same in each case. In the simpler form sensitive paper contained in the actinometer is exposed to the light at the same time as the negative is put out until it attains the same colour as the surrounding part of the face of the actinometer, and this is termed a "tint." Experience only can determine the number of tints for a given negative, but for one of medium density two or three should be about right.

When the correct exposure for a negative has been found, it is as well to register details for future use and as a guide for other negatives of similar density. There is no necessity to open the frame during printing operations, and as a rough guide it may be mentioned that pigment paper sensitized in a 4 per cent. bath is about three times as rapid as ordinary P.O.P.

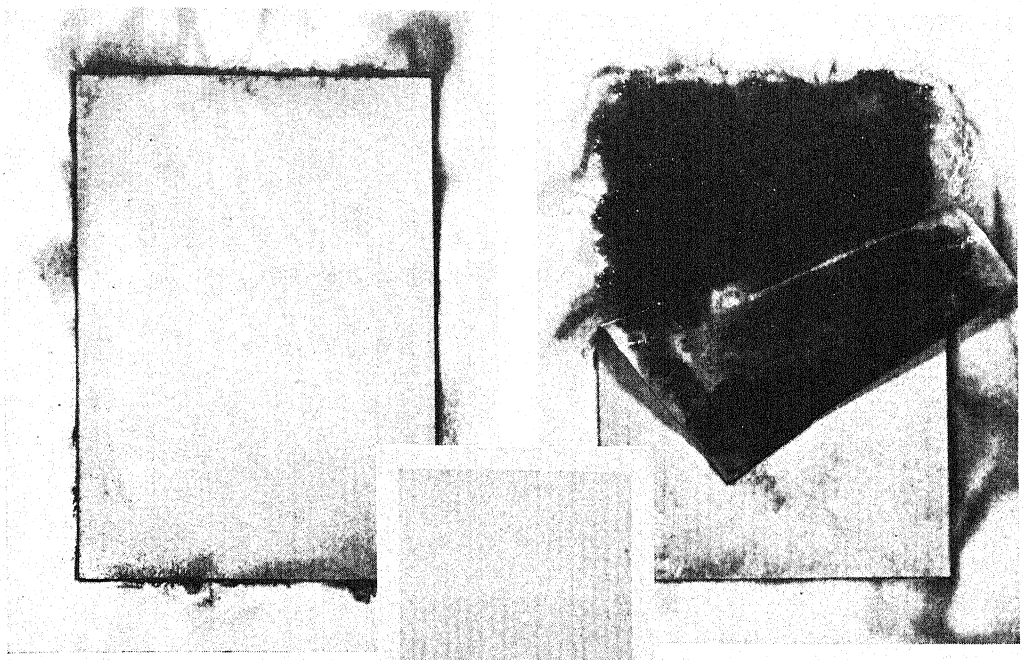
Up to this point the method of procedure will be the same whatever the nature of the support upon which the picture finally rests. This may be of paper, canvas, wood, ivory, porcelain, glass, metal, etc. The pigment paper after having been exposed to the action of light under the negative has the latent image formed in the pigmented gelatine which has been rendered insoluble according to the light-action through the negative. The insoluble image is upon or in the upper portions of the pigment coating, the soluble portions being the lower parts or those in contact with the paper on which the coating was originally spread. Development, therefore, must take place from the back, the face of the pigment paper being mounted upon some support to retain it intact during the process of development.

When printing has been judged to be complete, the pigment paper is removed from the frame and placed in a dish of cold water until the tendency to curl has nearly vanished. Assuming we are proceeding by the single-transfer method, it is placed in contact with the prepared side of a piece of single-transfer support which has also been previously thoroughly soaked in cold water. The two are then laid face to face on a piece of plate glass, or other smooth support, and thoroughly squeezed together. They are then placed between blotting boards and left for about 20 minutes, after which development, which may be carried out by day or artificial light, is proceeded with.

Development is commenced by immersing the mounted pigment and transfer papers in water at about 100°–105° F. In a short time, only a few seconds, the soluble parts of the pigment paper will begin to ooze out round

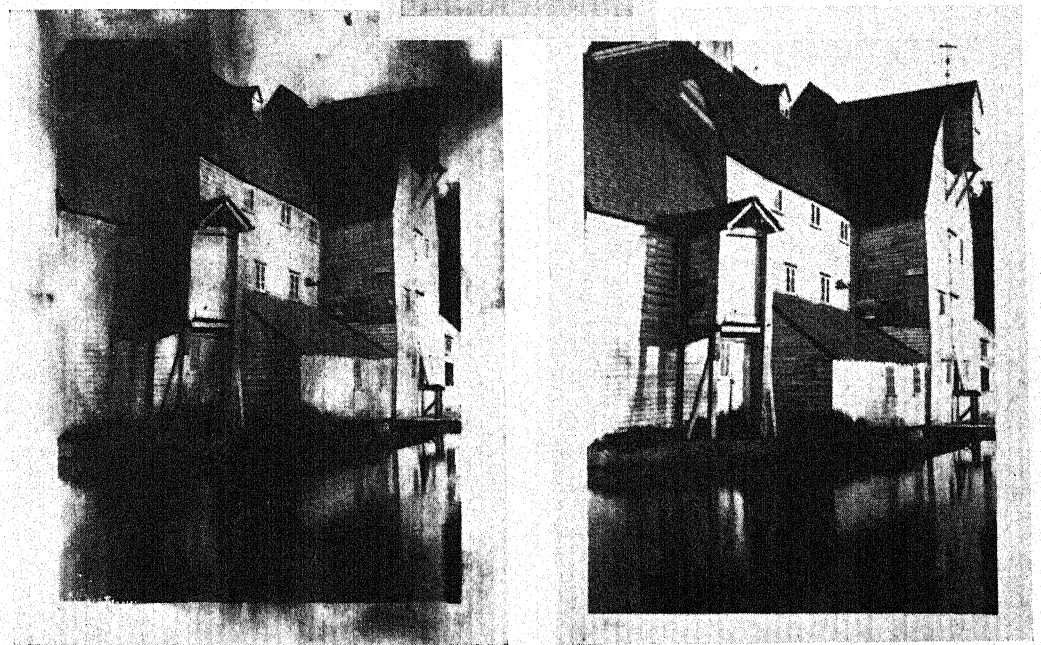


TISSUE AND TRANSFER. After printing, the exposed tissue and a piece of transfer paper are soaked in cold water, and then placed together as shown above. They are next squeegeed together and left between blotters for about twenty minutes



CARBON PRINTING : FIVE STAGES. Five stages in the production of a carbon print are shown here. Centre, pigment paper and mounted on support paper before immersion. Above, after immersion in developer, the pigment paper and support paper are withdrawn

The oozing of the pigment at the edges (seen in the photograph on the left) indicates that the pigment paper is ready for stripping. This operation, which must be done with care, is shown at the top



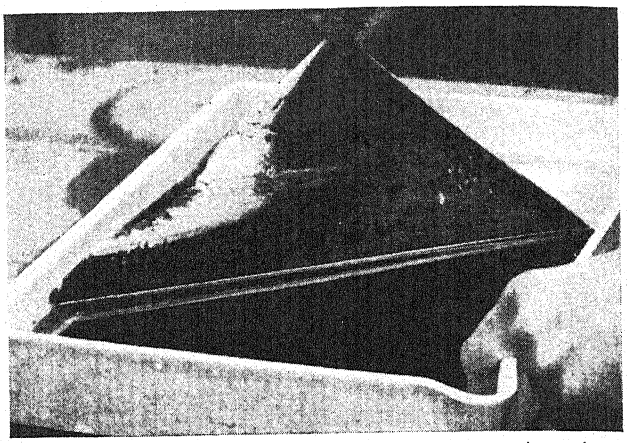
Here the image is seen partly developed. Note how the superfluous pigment is dissolving away. This occurs when warm water is gently splashed over the surface

The development completed. The print is now ready for immersion in cold water and is then transferred to a potash alum solution. A final rinsing completes the process

Photos, B. Chambers, F.R.P.S.

the edges, and this is the signal for gently stripping the two apart, care being taken to keep them under the surface of the water while doing so. The pigment paper is now thrown away and development of the image, which has now been transferred to the transfer paper, continued by gently splashing the latter with the warm water till all superfluous pigment has been dissolved away and the image fully revealed.

A certain amount of control is available during development, as by pouring a stream of slightly hotter water on to a given part a high-light can be "cleaned up" or shadow detail be more clearly revealed. When development is judged to be complete, the prints should be placed in clean cold water and then transferred to a 5 per cent. solution of potash alum until the yellow stain left in the paper by the bichromate has disappeared. After a final rinse in several changes of clean water the print is hung up to dry.



PEELING OFF THE TISSUE. The sandwich of tissue and transfer is placed in a dish of warm water until the pigment begins to ooze out round the edges, when the tissue backing, as seen above, is gently pulled off

Double Transfer

Development in double-transfer printing takes place upon a temporary support, the object being to bring the resulting picture into the correct position by means of a subsequent transfer. This temporary support may be of a rigid substance such as matt opal glass, or flexible like paper. Before use it is treated with a waxing solution, which allows the image to leave the support at the appointed time.

The general instructions given in the preceding pages on printing and development are applicable, but care must be taken not to overprint, as there is less latitude when developing upon a temporary support than in the case of single-transfer paper.

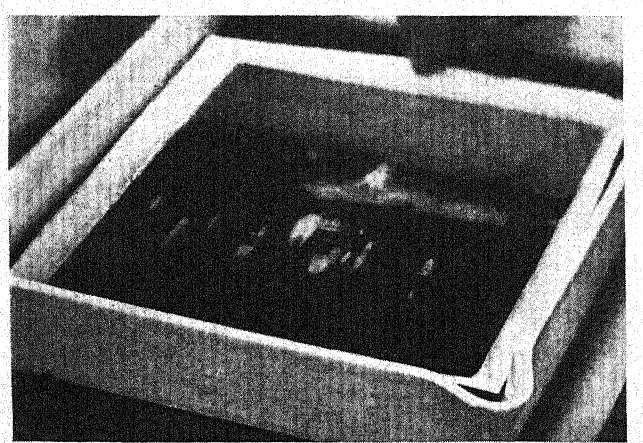
The temporary support, when put in the mounting water, will curl, only one side being pervious to water, and must be allowed to remain until it becomes flat before the pigment paper is mounted on to it.

After development the prints should be treated in the same manner as single transfer; that is, rinsed in cold water, put into the alum bath, again rinsed and hung up to dry.

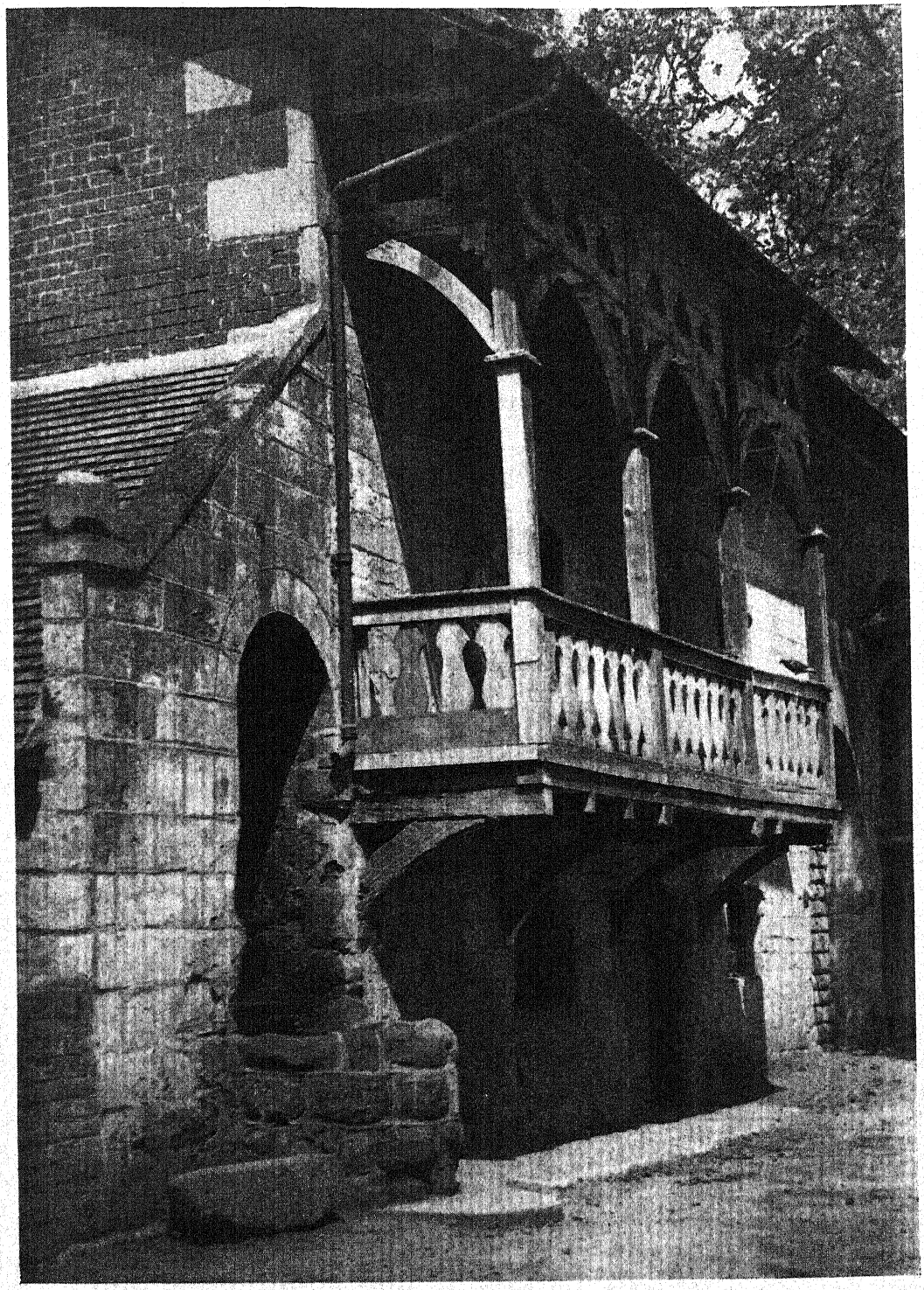
A piece of final support, larger than the print, but somewhat smaller than the temporary support on which it has been developed, should be soaked in cold water, then placed in water of about 90° F. for about two minutes and afterwards returned to the cold water.

The dry print on its temporary support is now put into the cold water till limp, and then placed face uppermost upon a smooth flat surface.

The piece of softened final support is placed upon it and the two lightly squeezed together. The transfer coating and the developed print,



THE LAST STEP. The warm water is now agitated, or the paper splashed, until all the surplus pigment has been washed away. The print is here seen developed and is then placed in an alum bath washed, and hung up to dry



BY CARBRO PROCESS. Remarkably fine results are obtained by adopting the Carbro method of printing, which is a combination of the carbon and bromide processes. An admirable example of a Carbro print is shown here in which the famous Guy's Cliff Mill, Warwickshire, is depicted. Another example of this process is reproduced in the art section in page 240

Photo, B. Chambers, F.R.P.S.

which is an image in relief, become one film on drying through the softened gelatine moulding itself into the inequalities of the picture.

The adhering papers are then hung up, and when thoroughly dry they are stripped apart, the image being found intact on the final support.

Besides the large number of pigment papers available, there is also a varied assortment of transfer papers, and as these cover a wide range of texture and tones, when taken in conjunction with the numerous colours of the pigment papers, they offer almost unlimited scope as regards the variations of results obtainable.

The Carbon Negative

Finally it should be pointed out that the ideal negative for carbon printing should be decidedly " denser " and " pluckier " than those employed for most other printing methods.

For a fuller treatise on this subject, the reader is referred to " The A B C Guide to Autotype Carbon Printing," published by The Autotype Co., Ltd., 59, New Oxford Street, London, W.C.1, who are also the manufacturers of the necessary materials.

CARBRO PROCESS FOR PRINTING FROM BROMIDES

B. Chambers, F.R.P.S.
Of the Autotype Co., Ltd.

The relations between the Carbro and Carbon processes are here described, and a clear summary given of the former's advantages and disadvantages, with full instructions for obtaining successful prints. The virtues include the use of bromide enlargements prepared in the ordinary way

CARBRO may be aptly termed the offspring of Carbon, for it is an adaptation of the latter process, and its origin is of a much later date.

A Carbro print is actually a Carbon, but, whereas in carbon it is the light passing through a negative which renders sensitized pigment paper insoluble in varying degrees, in Carbro this action takes place by a chemical reaction between pigment paper and a bromide print.

Advantages of Carbro

All the advantages possessed by Carbon cannot be claimed for Carbro, but, on the other hand, the latter process has advantages of its own, which appeal to the worker lacking facilities for daylight printing, or disinclined to make enlarged negatives. Furthermore, after the production of the necessary bromide print, all further operations can be carried out in full day or artificial light.

The full range of pigment papers and single-transfer papers, as described in the Carbon process (*q.v.*), are available for Carbro.

Anyone with facilities for making bromide prints, and a supply of hot and cold water, can attempt Carbro printing.

In addition to a bromide print and the essential chemicals, a supply of pigment paper, single-transfer papers and a flat squeegee are necessary.

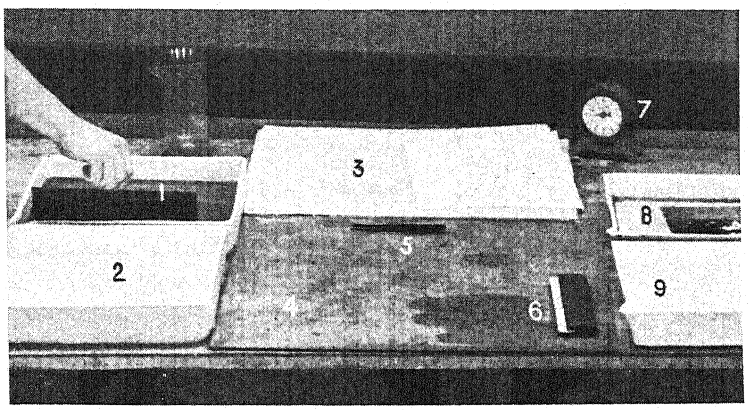
The two dishes which are to hold the solution should preferably be of porcelain, but enamel ones may be used provided they are sound. Papier mâché dishes are unsuitable. Two further dishes, or other vessels, will be required for soaking and washing purposes, and these, together with a piece of plate glass, a few blotting boards and some waxed paper, complete the outfit.

What actually takes place in the production of a Carbro print is that the chemicals absorbed by the pigment paper bleach the silver image of the bromide print and at the same time tan, or render insoluble, a portion of the gelatine of the pigment paper exactly corresponding to the image. This insoluble gelatine image adheres to the transfer paper but, during the process of development, all the soluble gelatine is removed by the warm water, leaving an image in relief, made up of varying thicknesses of insoluble pigmented gelatine.

It is this relief image which gives such superb depth to the shadows and other unique qualities which are characteristic of Carbro prints.

Just as the gradation and quality of a print made by the aid of light are dependent on the

quality of the negative, so is the excellence of a Carbro governed by the quality of the bromide print. Any of the standard makes of bromide paper may be used, those grades known as platino-matt or ordinary being the most suitable. Glossy papers are liable to give trouble when squeegeeing the pigment paper to them. Rough grades tend to retain air in the crevices, and to prevent good contact with the pigment paper, whilst chloro-bromide or gaslight paper is quite unsuitable. It has been found that bromide papers which have been supercoated in order to prevent stress marking frequently give Carbros with granular high-lights or from which the lights completely develop away. This trouble may be overcome by making prints somewhat stronger than normal, but it is better to avoid supercoated papers.



CARBRO BENCH LAY-OUT. (1) No. 1 bath. (2) No. 2 bath. (3) Wax paper. (4) Sheet of glass. (5) Knife. (6) Squeegee. (7) Timing clock. (8) Dish of cold water. (9) Dish for warm water. In the above illustration the bromide print is in the cold water bath (8), and the tissue is entering No. 1 bath (1)

Necessity for a Margin

As the quality of the bromide print is of the utmost importance, care must be exercised to ensure accurate exposure and full development. It is advisable to make the bromide print with a white margin all round—to form a safe edge, its purpose being to give a margin of soluble gelatine all round the picture, without which the Carbro may frill during development. Whether the bromide is masked or not, it is essential that the pigment paper overlaps the actual bromide image all round.

First of all, the bromide print and a piece of transfer paper are put into a dish of cold water to soak. Should any difficulty be experienced in determining the coated side of the latter, place the paper between the teeth and the coated side will adhere slightly. It is advisable to make a pencil mark on the uncoated side so that no doubt will arise later. For the thinner varieties of transfer papers, only a few minutes' soaking is necessary, but the thicker ones require longer; but any reasonable length of time can have no injurious effect. Next the two working baths are prepared, the composition of which are as follows:

Concentrated Stock Solution No. 1

Potassium bichromate	1 oz.
Potassium ferricyanide	1 oz.
Potassium bromide	1 oz.
Water	20 ozs.

Concentrated Stock Solution No. 2

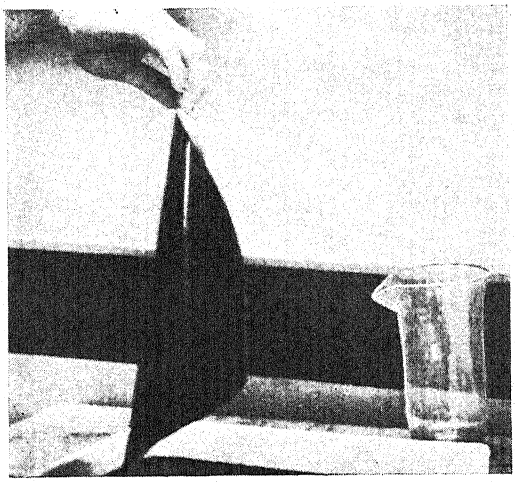
Glacial acetic acid	1 oz.
Hydrochloric acid (pure)	1 oz.
Formaldehyde (40 per cent.)	22 ozs.
Water	1½ ozs.

From these concentrated solutions the working baths are made up as follows:

No. 1 Stock Solution	6 ozs.
Water	18 ozs.
No. 2 Stock Solution	1 oz.
Water	32 ozs.

If preferred, these solutions can be obtained in convenient form from the Autotype Co., Ltd., of 59, New Oxford Street, W.C.1, the manufacturers of all the necessary materials required for the process. The first bath can be used for a considerable time, and so should be bottled for future use, but the second bath must be renewed frequently and thrown away after use. A 32-oz. bath of the latter would be enough for ten prints 12 × 10 in. The temperature of the working baths should be about 60°–65° F., as it is difficult to obtain good results should these be either too hot or too cold.

An ample quantity of the two working baths is now poured out in two separate



DRAINING THE TISSUE. For most colours the tissue is first immersed in No. 1 bath for three minutes. Then, holding it by one corner, as seen above, it is allowed to drain for about fifteen seconds

dishes and a piece of pigment paper immersed in No. 1 bath. At first it will show a tendency to curl, and care must be taken to keep it under the surface of the solution. Any air-bells that may have formed, either on the back or front, must be gently wiped off. After three minutes the pigment paper is withdrawn, and after being allowed to drain for a few seconds is then placed in No. 2 bath, care being taken to immerse it thoroughly without delay.

The time of immersion in No. 2 bath will vary according to the result desired, and a considerable amount of control is possible here, a longer immersion than normal tending to softness, and a short immersion to increased contrast and brilliance.

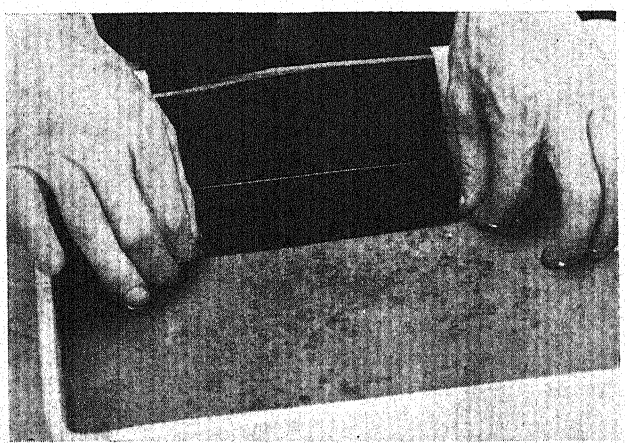
For a normal result, about 20 seconds will be sufficient. Different makes of paper vary somewhat in their requirements, but the principle is the same whatever make is employed; only experience can determine this, and also the minimum and maximum times of immersion, but periods of from 10 to nearly 60 seconds may be employed if occasion demands. In districts where the water supply is very soft, the immersion time in No. 2 bath becomes very short, and under such conditions the No. 2 solution may be diluted to 1 part of concentrated to, say, 45 parts of water, when the time of immersion required will be nearer 20 seconds.

Whilst the pigment paper is in the No. 1 bath, the bromide print is removed from the soaking water, placed face upwards on a level sheet of glass and the squeegee passed lightly over it so that it adheres to the glass. This will obviate any tendency to slip, and a little clean water is again poured on it. After three minutes the pigment paper is withdrawn from the No. 1 bath, drained for a few seconds, and is then placed in No. 2 bath.

At the end of the number of seconds decided upon it is taken out and placed without delay upon the bromide print in such a manner that the edge is square at the left-hand margin of the bromide. These two edges are then pressed down firmly with the fingers and the rest of the pigment paper quickly and carefully "hinged" down on to the bromide. The two are then thoroughly squeezed together by several strokes in each direction.

Great care must be taken during this operation to see that no movement takes place between the pigment paper and the bromide, otherwise a double image will result.

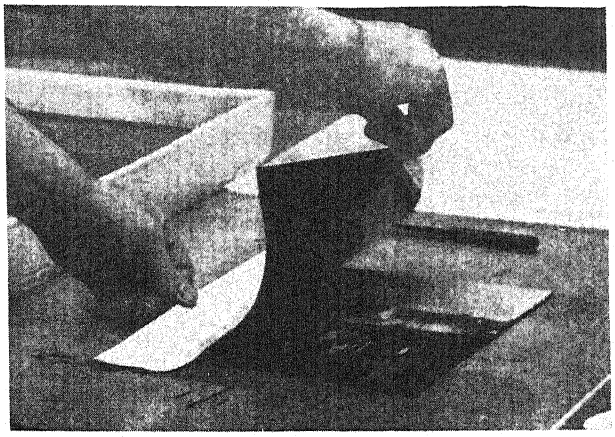
It is further necessary to make quite sure that the pigment paper overlaps the bromide image all round. When this has been done the adhering pigment and bromide papers are placed under slight pressure, such as a few blotting boards, and preferably between sheets of waxed paper, as this



SECOND IMMERSION. After the step illustrated above, the tissue is slid into the solution of No. 2 bath for about fifteen to twenty seconds, according to the result required

prevents evaporation and so assists the action of the chemicals, and they are so left for about 15 minutes.

Then the pigment and bromide papers are gently stripped apart. The bromide print is dropped into clean water to be subsequently dealt with and the pigment paper placed on the transfer paper, which has previously been taken from the soaking-water and laid, prepared side upwards, on to the sheet of glass. These two are then squeezed together and again placed between the blotting boards, this time without the waxed paper, and left for about 20 minutes. Movement between the pigment paper and transfer paper is of no particular importance.

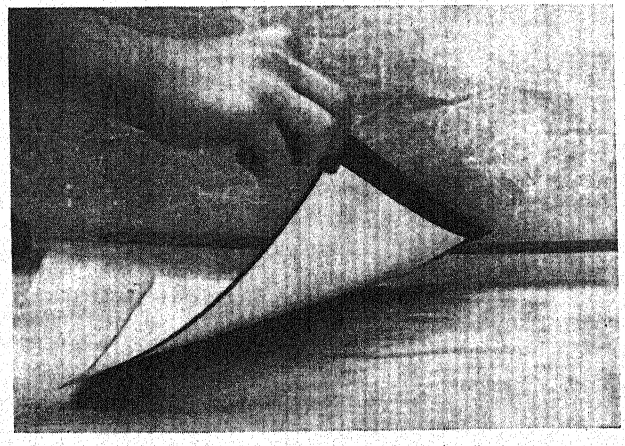


ON THE GLASS. The bromide print is now placed face upwards on a sheet of glass, and the tissue removed from No. 2 bath is placed on it as here shown, and squeegeed

The procedure from now onwards is the same as described in the development of the Carbon print. The pigment paper and bromide are removed from the blotting boards and placed in a dish of water at about 95° F., the pigment paper uppermost, and left until the pigment is observed to be oozing out all round the edges. This is the signal for gently stripping the two apart —care being taken to keep them under the surface of the water while doing so. The pigment paper is now thrown away, and development of the Carbro image, which has been transferred to the support paper, is completed by gently splashing it with the warm water until all superfluous pigment has been dissolved away. A certain amount of control is again possible at this stage, as by directing a stream of slightly hotter water high-lights can easily be brightened up and the density of shadows reduced. Care must be exercised in doing this, otherwise the high-lights and delicate half-tones may be washed out or become patchy.

When development is complete the print is rinsed in cold water and transferred to a 3 or 5 per cent. solution of potash alum, which will discharge the bichromate stain left in the transfer paper. When all traces of yellowness have disappeared the print is rinsed in several changes of water and hung up to dry. This latter stage should not be hurried, otherwise there will be a tendency for the print to cockle unduly. Whilst the Carbro print is wet it is very delicate, and the surface should on no account be touched.

When the pigment paper has been stripped from the bromide print, the latter will be found to have bleached out to a pale yellow colour, though some of the deeper shadows may not have been so affected. The bromide, after a thorough washing, is redeveloped—no further fixing being necessary —and is again washed, after which it will be ready for making further Carbros or it can be dried and put away for future use.



THE TRANSFER. The sandwich is next placed between wax paper or grease-proof for about fifteen minutes. A piece of transfer paper is soaked in cold water for about five minutes, and, with this laid on the glass, the tissue is placed in contact. Henceforth the process is identical with Carbon printing (see illustrations in p. 244, at bottom, and p. 246)

Instead of developing the Carbro image on a new support, it is quite possible to do so on top of the bromide print and so avoid transferring. In this case it is essential to mask the negative before printing so as to give a white safe edge to the print. The procedure is the same as in the Carbro up to the point where the pigment paper should be stripped from the bromide. Instead of doing so, however, at the end of 30 minutes' contact the two should be placed, still adhering, into the hot water and developed straight away. A picture of a composite nature is then formed, with the Carbro image on top and a bleached bromide underneath. It is not advisable to leave it in this condition, as the bleached image may change colour in time. It should be washed and fixed in plain hypo, or better still hypo and ferricyanide, and finally should be well washed again.

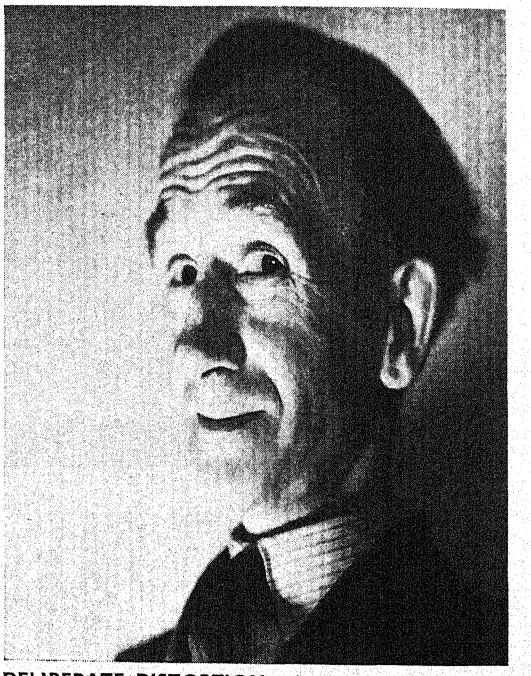
As an alternative, the silver image is redeveloped under the Carbro, thus reinforcing the latter image, and this method will be found useful when dealing with an under-exposed negative which will only yield a weak print.

Many unusual effects may be obtained by combining pigment papers of suitable tones with the black bromide print.

CARICATURES & CARTOONS. The making of caricatures by photographic means has engaged many minds since the early days of photography. None of the methods appears to have been extensively used, probably because those which produce the most effective results are not entirely under control. For instance, melting the gelatine image is a simple means of obtaining a grotesquely distorted picture or portrait which has been employed to advantage occasionally in cinematograph films. Naturally, one would hesitate to experiment in this way upon the original negative itself, and the coating upon bromide paper is too tough. The best plan, undoubtedly, is to make some positive transparencies on dry-plates, which are fixed without any hardener in the bath. Warmth must be applied gradually and cautiously, because once the melting commences the gelatine is apt to run too quickly. For this reason the plate, while still wet, is best held with the film towards the source of heat, rather than the glass, which would hold the heat and prevent stoppage at the desired stage. Selection of a result, rather than control, is indicated.

Distorting mirrors offer a more controllable means, but have corresponding disadvantages. They must be larger than the subject photographed, and used close to it. This entails difficulties, though not insuperable ones, in lighting satisfactorily the side of the subject facing the mirror, and it is rarely practicable to obtain good definition over the whole picture. The chromium plates sold for glazing prints afford a means of producing various effects by bending them to slight but different curvatures, but their size is rarely large enough.

The late Herbert G. Ponting, celebrated for his fine photography of polar explorations, invented apparatus for producing both cinematic and still distortions. It produced astonishing variations of a face or other subject, but details appear never to have been made public. Distorted faces made in these ways have been used in advertising, mainly to suggest distortion of sound. It is probably the absence of pre-control which has prevented other applications.



DELIBERATE DISTORTION. A caricature produced by projection-printing and bending the bromide paper during exposure

Photo, Bernard Alfieri, Jr.

Another method is to bend the bromide paper during projection-printing, the results obtainable resembling the illustration in the opposite page.

Some actors and others have the power of assuming grotesque features, and the application of unusual lighting to such grimaces offers many possibilities. Exaggerations of natural defects can sometimes be made by using a tilted easel in enlarging. A thin man can be made to appear absurdly tall and thin, and a fat man much broader, in this way.

Cartoons have been made in various ways. There is the familiar comic figure painted on a canvas screen, with a hole for the " sitter's " face to peer through. That method is employed by the seaside post-card photographer. It is not difficult to make a small print of a full-length portrait and paste in position an enlarged cut-out of the head. Those gifted in pencil drawing prefer to make a print on matt-surfaced paper of the head only of a portrait, and to sketch upon it the body in the manner of the newspaper cartoon.

For cartoons in sub-standard cinematography, *see* the following article.

DAVID CHARLES, F.R.P.S.

CARTOONS WITH A CINE CAMERA

Stanley W. Bowler, A.R.P.S.

The popularity of " Micky Mouse," " Pop-Eye, the Sailor," and other famous screen cartoon personalities, makes this subject one of great interest ; the article that follows, however, is not restricted exclusively to drawn cartoons, but deals also with the manoeuvring of jointed models and the combination of cartoon with natural photography

See also Caricature ; Stop Motion

UNDER the general heading of Cartoons is classed all that type of stop-motion work which is built up from drawings, whether these are alone or combined with straight cinematography. The simplest type of cartoon work is probably that seen in maps which indicate the route of an exploration by means of a growing and travelling line. In this case the map is photographed one frame at a time, and the line is increased very slightly in length between the photographing of each frame. From this simple instance it is but a step to simple figure work, where a jointed figure appears to move across the screen. Again one frame at a time is photographed, the figure being moved slightly between each frame to simulate the actions of walking, running, etc.

Naturally, the limitations of this type of work are marked, and the next stage is the production of a series of drawings on which may be a simple background with several figures all moving at the same time, each figure being redrawn in a new position for each separate and consecutive frame that is photographed. With only one piece of paper to work on, the background has of necessity to be redrawn for every frame of animation. The way out of this difficulty is to have the background on one sheet of paper which is registered on to location pins or pegs at the top of the photographing easel, and the figures drawn on another series of sheets of paper which are registered on to location pins or pegs at the bottom of the frame area. This means that the figures must be " cut-out " round their outlines so as not to obscure the background above them. The limitations of this method are obvious.

The next stage is the substitution of a transparent celluloid " overlay " for the papers on which the figures are drawn. With these celluloid overlays, or " cels " as they are called, there are almost unlimited possibilities of action available, since at least two or three may be used, one on top of the other, over the same background.

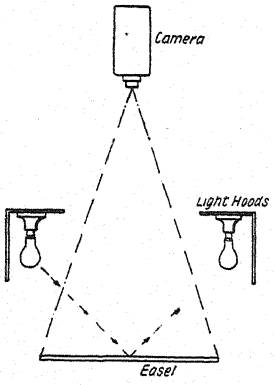
When purchasing celluloid for overlays, always buy non-inflammable material, as a number of sheets of ordinary celluloid constitute a very grave danger. The sheets should be about 5/1000 *of an inch thick.*

The drawings are usually made on these " cels " in non-waterproof indian ink (sugar may be added if the ink will not adhere to

the polished surface), and then the figures are made non-transparent by painting-in with different tones of grey poster-colour on the reverse side.

Composite Natural and Cartoon Cinematography. One other piece of trick-work which may be tried is that of combining natural and artificial cinematography. The base of the cartoon easel is replaced by a sheet of ground glass, and the pictures from an existing film are projected from below on to this sheet of ground glass to form the background for a series of drawings made on celluloid sheets, and the two photographed on to the film in the cartoon camera. As each fresh drawing is placed on the cartoon bench or easel, the picture in the projector is moved on one frame.

The work involved in the preparation of animated cartoons, while not necessarily difficult, usually takes some considerable time. For this reason it should be simplified in every possible way. The requirements may be briefly summed up as follows: 1. A camera capable of making a series of exposures one after the other, though at different intervals of time, each exposure being identical in length of time. 2. Some fixed lighting arrangement which will give even illumination. 3. The easel upon which the drawings, titles, jointed figures or the like are placed to be photographed. This set-up is illustrated very simply in line diagram above. It is essential that the relationship between the three component parts of the set-up is rigidly maintained, so as to reduce the number of variable factors to a minimum.



Arrangement of equipment for Cartoon work (see text)

1. The Cartoon Camera. This may be a standard camera which has some provision already built into it for making a series of single exposures of even length, or may alternatively be a camera of the hand-turned type with either (*a*) a constant speed mechanism coupled to it through a single-picture clutch, or (*b*) an external shutter placed over the lens and independently operated after the film has been moved on one frame after each exposure.

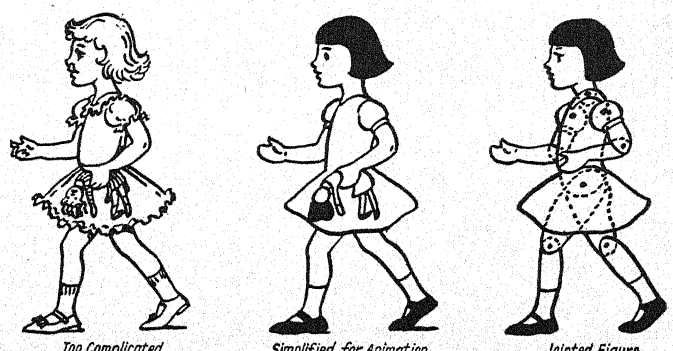
2. The Lighting Equipment. This must be so arranged as to provide an even field of illumination over the entire area covered by the camera, and also arranged so that if a cover glass is used to weight down the papers, etc., no reflections return into the camera lens. Usually, the source of light is split into two banks, one at each side of the photographic area, and fitted into two hoods (*see* diagram on left).

3. The Cartoon Easel. In its simplest form this is merely a board upon which the area covered by the camera lens is clearly marked. Variations to produce simple but effective shots are as follows:

(*a*) The base may be of glass, so that it may be lighted from below, and translucent paper used.

(*b*) It may be arranged to slide between guide rails both horizontally and vertically, to give the illusion of panoraming and tilting shots. In this case, finely divided scales should be provided on the guide rails, with a pointer on the easel for reference purposes.

(*c*) The base may in addition be arranged to move closer to or farther away from the camera so as to give the effect of "trucking" shots. In this case the lens must be correspondingly adjusted for focus.



CARTOON DRAWING AND DOLL. Above is shown how to simplify, and how to "joint," a figure for animated Cartoon work

Cartoon Drawings, Models, &c. When starting cartoon work, and if little artistic skill is available, all drawings, models, jointed figures, etc., should be kept as simple as possible. The illustration in p. 252 demonstrates this point. Shading or other decorative lines should be avoided, as they introduce considerable complication which must be reproduced in every drawing for each frame.

Registration of Drawings, Models, Figures, &c. In order to preserve the illusion of a smooth flow of movement on the screen, the individual steps in the movement between one frame on the film and the next must be carefully worked out. As a simple guide, an allowance for movement between one frame and the next of one per cent. of the frame width or height is fairly satisfactory. A number of small movements on which only one exposure each has been made is likely to give a smoother action than large movements upon which a number of exposures have been given upon each. When using jointed figures a " track " for the movements should be prepared. For working on a white background, a very lightly used blue crayon will serve to indicate the track—on a black background, a dark red crayon lightly used. The crayons should preferably be non-greasy. When using a series of drawings, it is essential that some form of pilot pins be provided, on to which the papers can be placed so as to maintain an exact relationship between succeeding drawings. For this purpose a wide-spacing, letter-filing punch, or a pair of letter-filing punches linked together, can be used for punching the holes, and two screws (with the heads removed) in the easel for the " pegs " upon which to place the punched drawings.

CASSETTE. The name given to a particular kind of light-tight spool chamber used in miniature cameras employing cine film. The following description applies particularly to the Contax cassette, but others follow the same principle.

The Contax cassette consists of an inner core and an interior and exterior sleeve, each provided with an elongated opening through which the film can be threaded. On top of the exterior sleeve are two small studs, one of which is spring-mounted, so that when it is pressed down the inner sleeve can be rotated within the outer one. When the two openings overlap to the extent of about half the opening, the inner sleeve can be withdrawn.

The spool of film is then inserted in place of the cassette core so that the cap of the spool appears in the upper opening, next to the small studs. The two cassette sleeves are now placed one within the other and turned until the two openings are superimposed. The film is then turned by means of the projecting cap until the beginning of the black protection paper can be seen in the cassette opening. The sealing strip is next removed, and the paper and film end withdrawn until the words " Kassette Schliessen " (close cassette) appear.

The spring stud is now pressed down, and the inner sleeve rotated in a direction opposed to the film travel until the stud clicks into the catch provided.

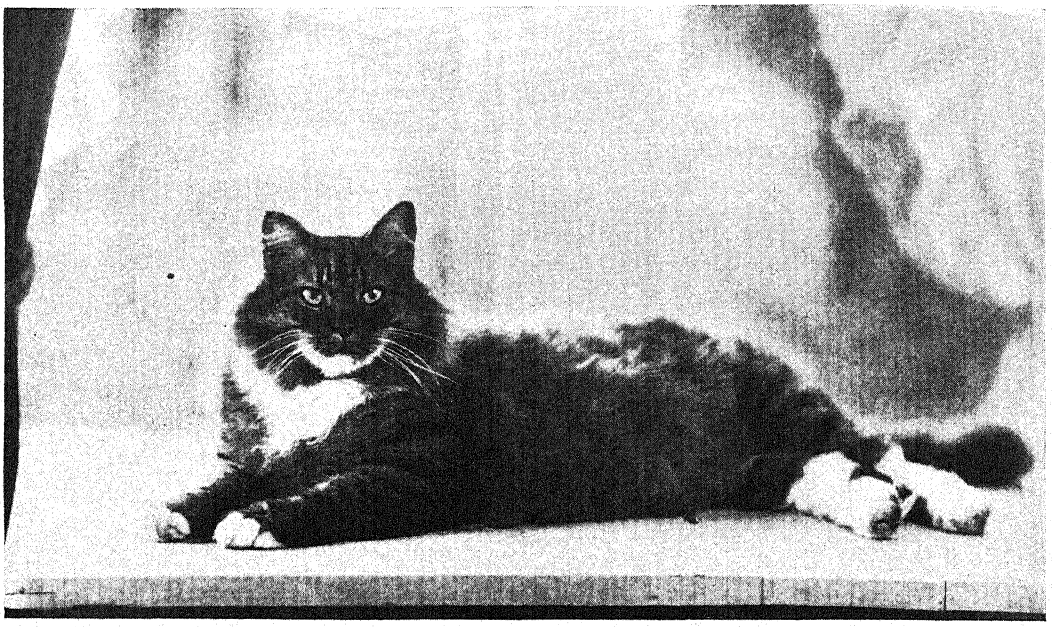
The loaded cassette may now be used in the same manner as an ordinary spool of film, the free end of the film being threaded through the spool slit on the opposite side of the camera.

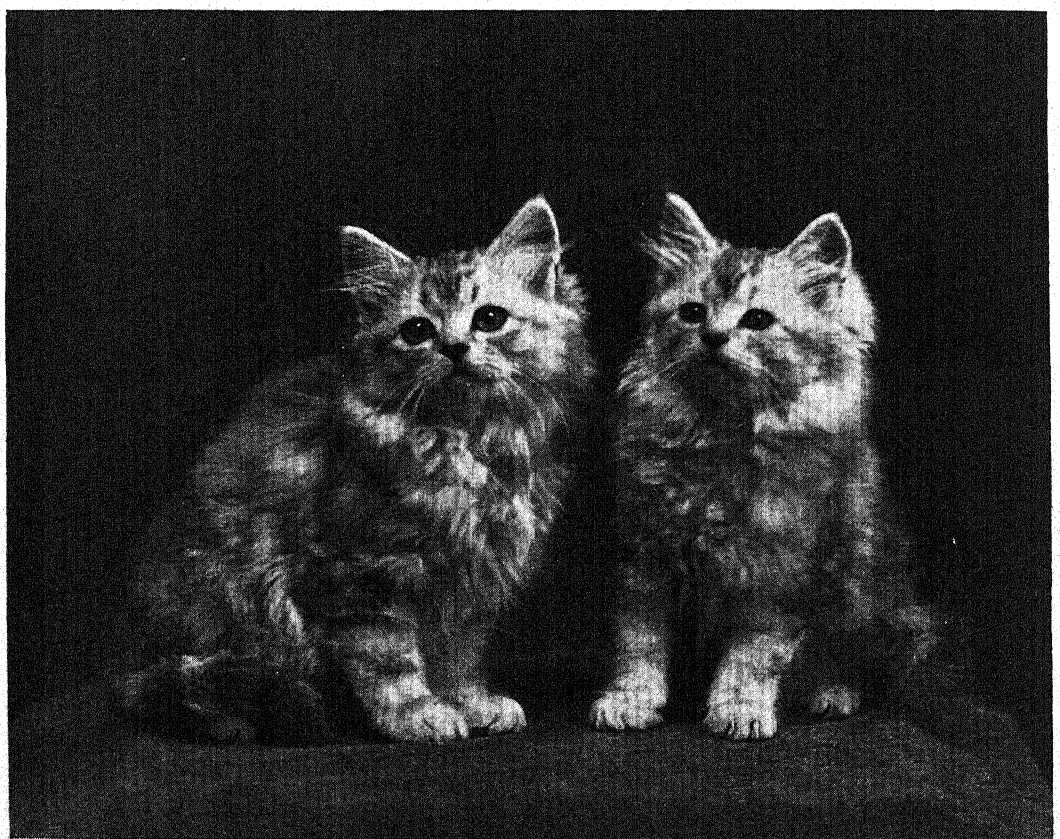
After exposure of the entire strip of film, it must be wound back into the cassette, unless a second cassette is used on the opposite side in place of the ordinary spool.

Although ordinary spools, similar to that of an ordinary roll-film camera, can be used with the Contax, a cassette must be used for loose, unpacked cine film.

Varied Sizes of Cassette. Although the standard cassette described above is made to hold sufficient film for 36 exposures, other sizes are obtainable, that for the " Leica 250," for example, holding 33 feet of film, allowing rather more than 250 exposures to be made with a single loading, whereas the cassette of the Agfa " Karat " takes 22 inches, sufficient for 12 exposures.

The Robot camera has a cassette which is semi-cylindrical in shape, with a light-trapped aperture which is kept closed by springs when not in the camera or when the camera is open. Closing the camera automatically opens the trap just sufficient to allow free passage of the film. The Robot cassette holds nearly five feet of film, which is sufficient for nearly 50 pictures. *See* Film : Miniature Camera.





IN STUDIO SETTINGS. Top, a picture taken with the subject in a bay window. Tissue paper was arranged behind, to give an opaque background. A 500-watt lamp was arranged near the cat. Bottom, two kittens with slight blue markings brought out by panchromatic material

Photos, Thomas Fall

CAT PHOTOGRAPHY: A DELICATE ART

Thomas Fall, A.R.P.S.

Cats are temperamental "sitters" to the photographer, and much of this article is devoted to the writer's experiences in ways and means of persuading them to pose. Mr. Fall is one of the world's greatest experts in posed animal photography, and his own photographs among the illustrations in the next few pages form a pertinent commentary on what he has to say in the text

See also Dog, and Horse Photography

Of all our domestic pets, cats are the most suspicious. Any unusual sound or unfamiliar object in their accustomed haunts is sufficient to make them immediately retire into some inaccessible place; or they become timid and difficult to manage.

Photographing cats can either be a simple matter or an irritating and tedious task. To obtain a photograph of an "easy" cat, any camera in a good light, with a fast film or plate, plus a little ordinary photographic knowledge, will suffice; but unfortunately the vast majority of cats are not "easy"—they are extremely difficult subjects. An *easy sitter* includes the cat that can be coaxed into a suitable spot and can be kept amused and interested by its owner, completely oblivious to the camera and the photographer, who can reel off shot after shot. A *difficult sitter* can only be successfully tackled at the cost of infinite patience on the part of the photographer, who must be equipped with suitable apparatus and original ideas.

Cameras to Use

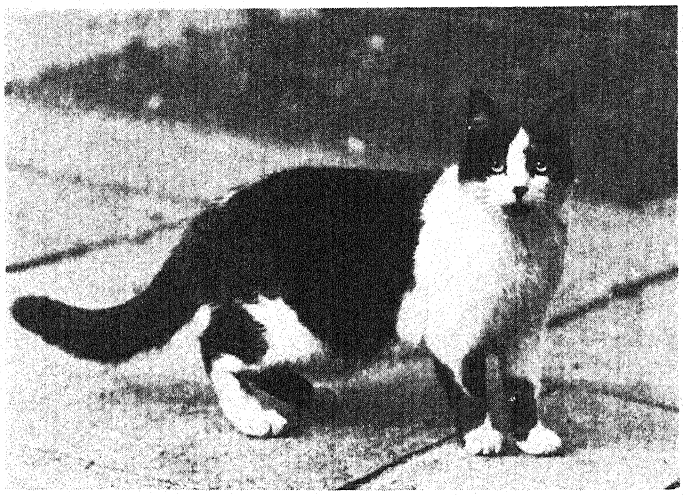
Dealing first with apparatus. The miniature camera has certain advantages: it can be fitted either with short or long-focus lenses, giving great depth of focus and a very bright, crisp image that enlarges well; the combined range-finder and view-finder enables the subject to be kept under constant observation; and the response to the shutter release is very quick. The fact that most of these cameras allow of 36 exposures being made with one loading is a boon, for probably only a small proportion of the exposures will eventually find their way into the enlarger.

A reflex camera also has its particular advantages: the image on the focussing screen is much larger, and the camera can be held suspended round the neck by a strap, pressed well against the chest and partially camouflaged by covering it up with the coat (taking care to keep the coat clear of the shutter controls).

But the reflex camera has its disadvantages. Most of them have focal-plane shutters, and there is a short time-lag in making the exposure, due to the necessity of getting the mirror out of the way. Moreover, this type of shutter is not famous for its silent working; there is a pronounced snap when the shutter is released, and the re-setting is sometimes rather a noisy procedure. The easiest and most amenable cat sitter can be scared away by the snap of a shutter.

Focussing Without the Sitter

A very ordinary camera, even though it requires the use of a focussing glass and a camera cloth (which, of course, should not be thrown or flapped about), will often give very good results, provided it has a silent shutter, and this type of old-fashioned camera can often be fitted with a behind-the-lens shutter that makes no noise in opening or re-setting. Such a piece of apparatus can only be used when the cat can be lured to a fixed spot which can be focussed beforehand, the limits of the focus noted, and the exposures made only when the sitter is within such limits. Often the cat's most favourite haunt is suitable, either on the back of a couch or the top of a table. The more confined and limited the space the better from a focussing point of view. A window ledge, or the top of a low wall or parapet, can be a useful spot. Cats can often be attracted to such places and kept there after the camera has been focussed and all set ready, and exposure after exposure can then be made quietly and with deliberation, provided no violent movement is made and nothing done to excite suspicion. This method of fixing the focus on a spot, camouflaging the camera, and moving about quietly and deliberately can be applied with any type of camera. When it



ARRESTED ACTION. This photograph, made with a miniature camera, was obtained while the cat's attention was momentarily turned towards a bouncing ball
Photo, Thomas Fall; ortho. film, 1/200 sec.

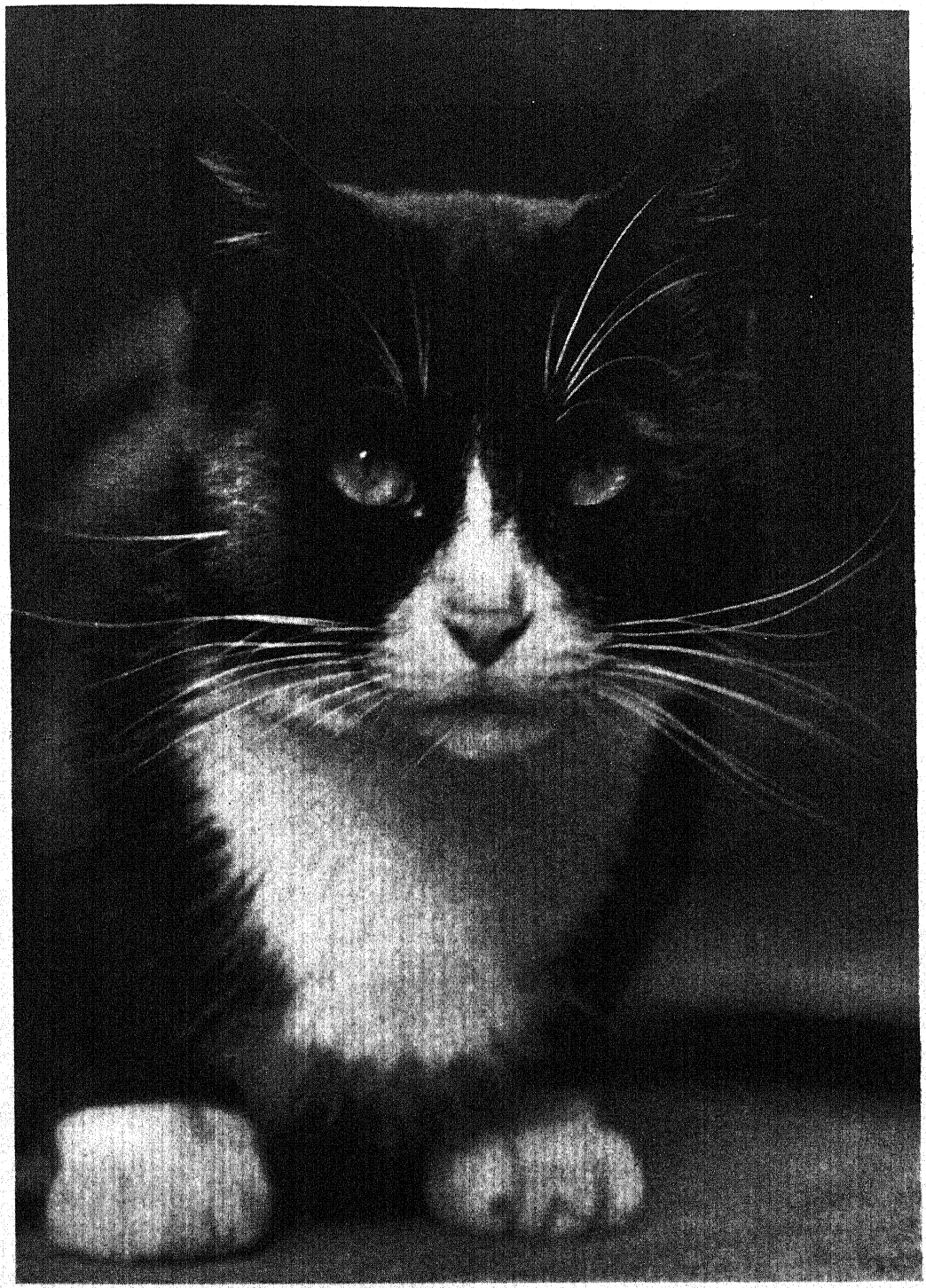
is used quite slow exposures are possible, even down to 1/10 sec., or slower films can be substituted for the ultra-rapid.

Nevertheless, ultra-rapid films or plates should generally be used, for the exposure often has to be the quickest possible. Panchromatic emulsion should be used for Siamese, Chinchillas, Abyssinians, ordinary striped tabby cats, tortoise-shell, and those with red or brown markings; they also give better rendering of the eyes. The blue Persian cat also photographs best with panchromatic films or plates, but cats in which black or white predominate are best rendered with orthochromatic emulsions. An entirely black cat is a difficult proposition, and panchromatic should *not* be used. A pure white cat is best photographed on a slower film, with a well-controlled light, for it is difficult to get good detail in the coat of a white cat unless the lighting is very subdued.

Lighting. This should be arranged according to whether a pictorial study or just a likeness of the cat is required. For the former a great deal of licence is allowable, such as heavy shadows with the illumination on part of the subject only, but in all cases there should not be a preponderance of back or side lighting, since this tends to make the edges of the coat lose some of that exquisite fluffiness that is so desirable in cat pictures. The lighting must be adequate for quick exposures. Cats delight to bask in sunshine, and a bay window is often a good place to turn into a studio, especially if it has a good wide ledge, or a small table can be placed in the bay. The portion of the window immediately behind the cat can be covered with a curtain of suitable colour to cut out the back lighting, and half-watt electric lights used to assist the lighting or simulate the sunshine. Care should be taken not to fill up the eyes with the light by using too much, for cats' eyes, though given to shine in the darkness, can be quite spoiled by over lighting. One direct light is better than a battery of lights. A cat will often settle down after a few moments in the full light of a powerful electric reflector. Flashlight should not be used.

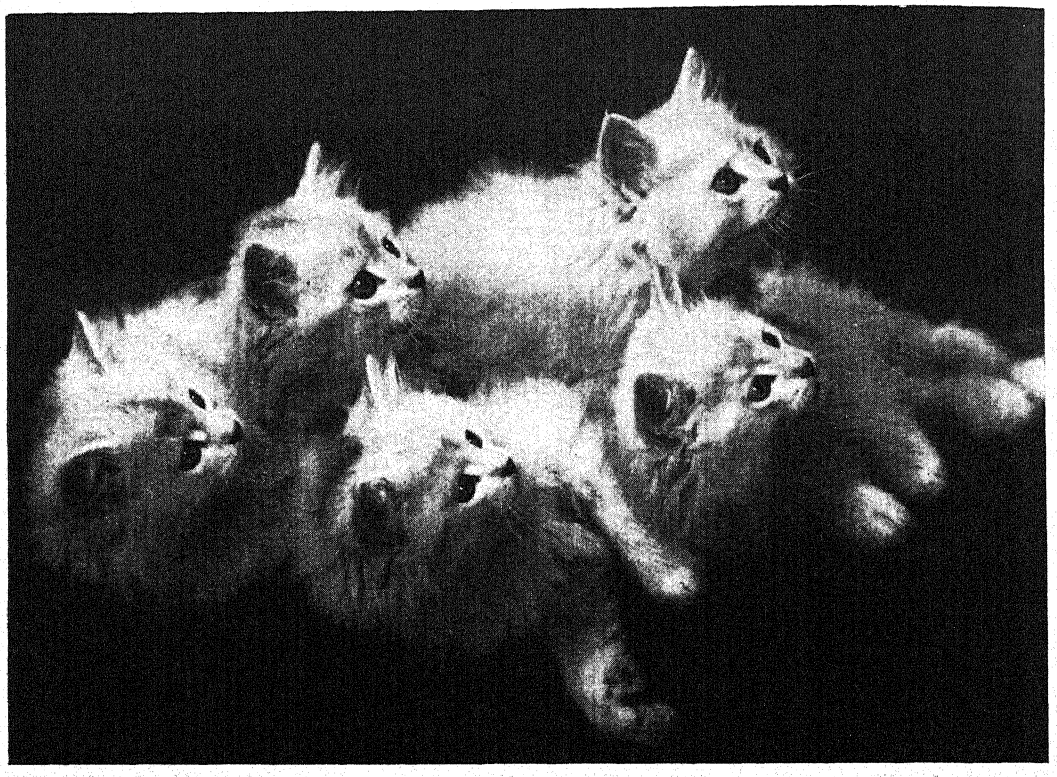


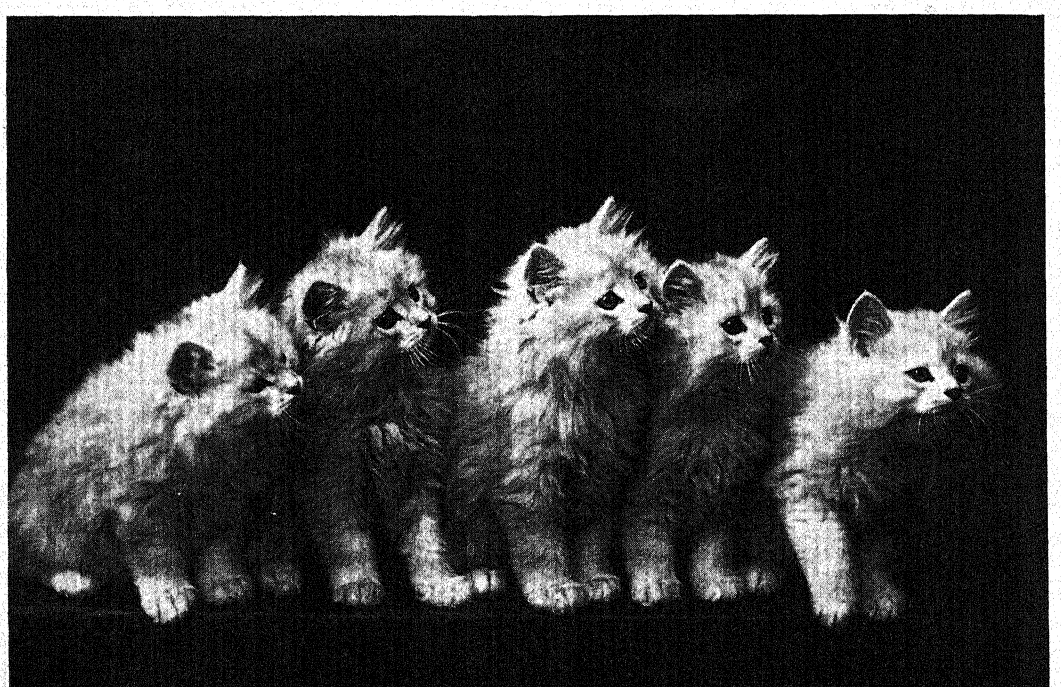
THE RIGHT MOMENT. Another example of a photograph taken while the subject remained motionless for a brief period. Action photographs are difficult because of the very swift movements of the animals
Photo, Thomas Fall; ortho. film, 1/200 sec.



DETAIL IN A CLOSE-UP. The excellent rendering of the eyes and texture of the fur in this cat portrait is largely the result of using ultra-rapid panchromatic material. Where the animal is pure white a slower film or plate with subdued light is necessary

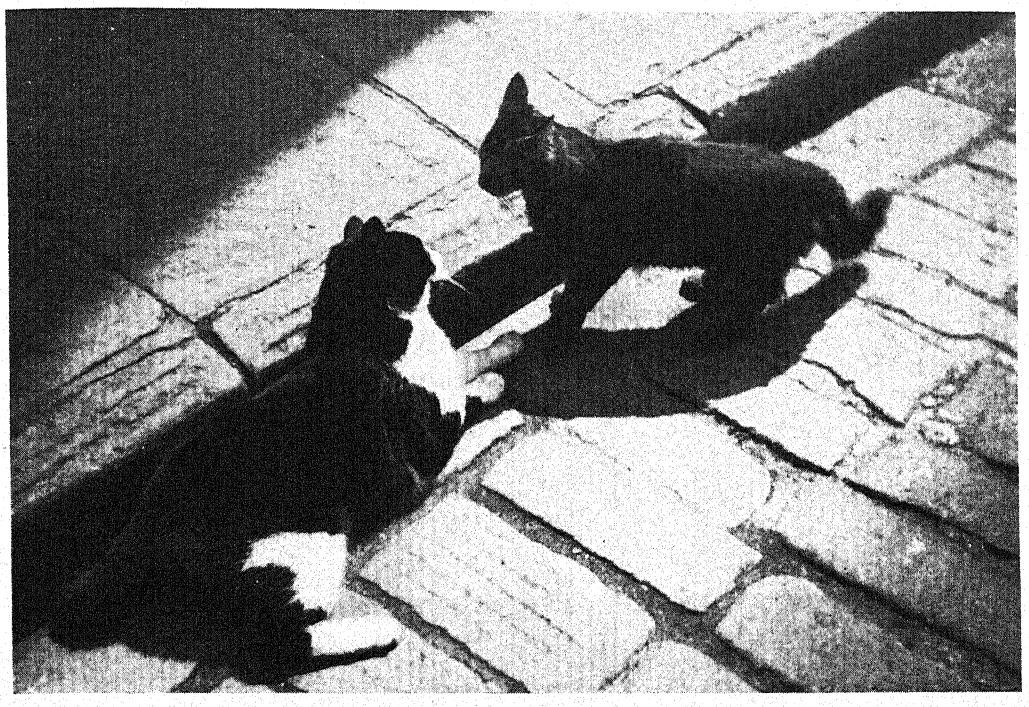
Photo, A. H. Roche; T.P. Reflex, Ross Xpres at f4.5, 1/25 sec.

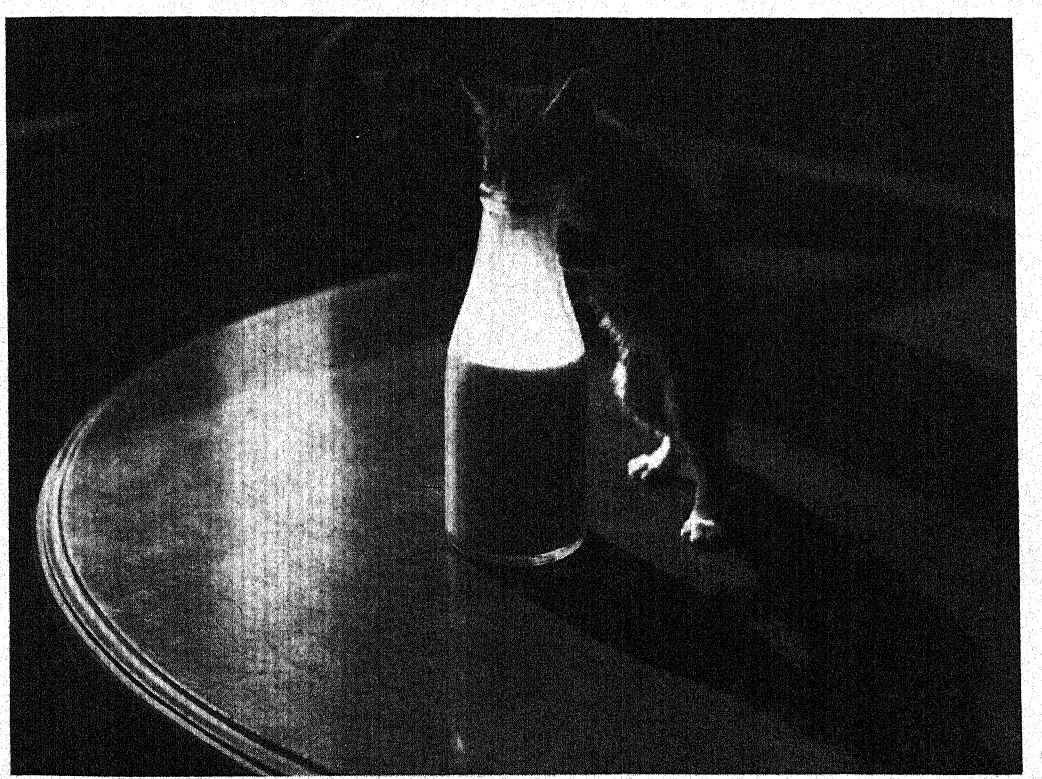




STUDIO GROUPING. Great patience is required in photographing a group of kittens, for the extreme restlessness of the little sitters makes successful shots difficult. By waiting until the kittens have exhausted themselves the photographer is able to obtain a natural reclining group as in the upper picture. The same group is then made to sit up for the lower picture, alert but not ready for play, by means of a dangling string

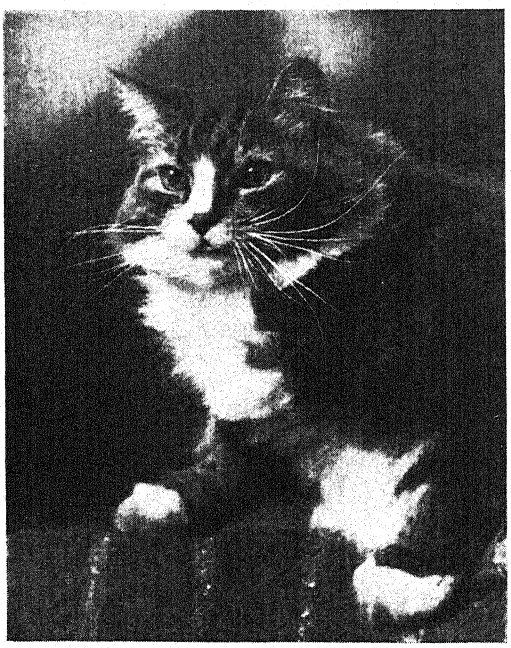
Photos, Thomas Fall





MOODS AND MOMENTS. In obtaining these two pictures the photographers took full advantage of their momentary opportunities, for the cat, with its swift, uncertain movements, is a difficult sitter, making natural action photographs none too easy to secure. The miniature camera scores in this field

Upper photo, John H. Ahern; Rolleicord, f5, 1/25 sec. Lower photo, C. D. Notley



MINIATURE SNAP. The miniature camera can be used with advantage for snaps of this kind, in which the cat subject has been caught in the act of scaling a garden wall

Photo, Thomas Fall ; pan. film, 1/200 sec.

Cats' movements are so quick that it is very difficult to get good pictures of them while moving. When they play, roll over and " catch at " things, they move so quickly that there is often too much movement in the print to permit a really satisfactory enlargement.

The colour of the background depends, of course, on the lighting, the colour of the cat and whether the film is panchromatic or orthochromatic. It is better to avoid strong contrasts, such as photographing a black cat against a white background. Grey is better, or a decided off-white. Similarly, a white cat should not be photographed against a dead black background. Avoid the edges of the fur sticking out in a wiry fashion by choosing a background without too great a contrast. Pay special attention to the colour of the background when using panchromatic films, or the " disappearing cat " trick can be produced unwittingly.

There are many methods of obtaining a cat's attention, but the difficulty is to hold the attention. The rustling of tissue paper ; a buzzing noise like a fly ; a step on adjacent stairs or path, rubbing a moistened finger up and down a window pane, or similar noises will often suffice. More violent noises can be tried later, if these are not successful. A piece of paper dangled at the end of a piece of string on a long stick is often useful, and the cat can be made to look in any direction by varying the direction of the stick. Violent agitation of the stick should be avoided.

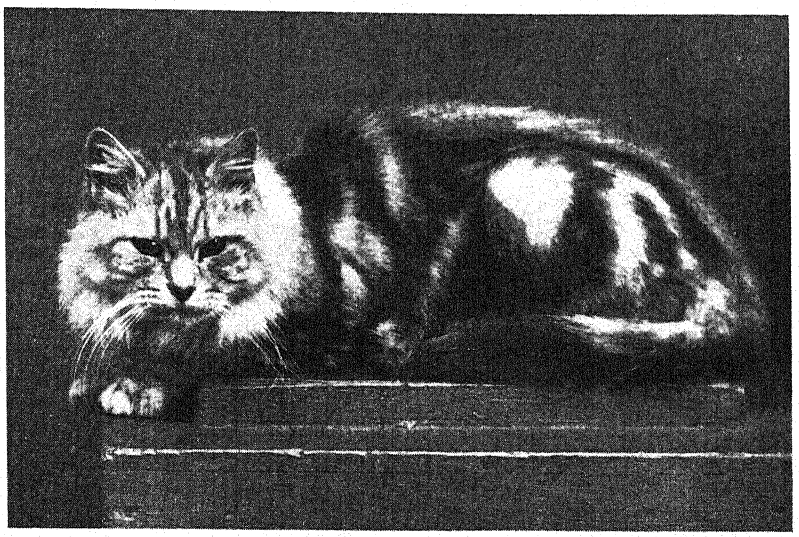
Show Cats, Prize and Pedigree Cats. These require special treatment, and it is advisable to find out from the owner any special points to emphasize or to hide. Whether, for example, the position should show a long or short face ; light or dark eyes ; close or wide ears ; a narrow or broad face and forehead. Remember, if the cat is lying down with the camera above and pointing down at the cat, the ears will photograph as if they were small and buried in the fur ; if the cat sits up and the camera is below and pointing up, the ears will stand out from the fur and look large. Some show cats are difficult to handle, and only their owners should attempt to touch them. They should not be let loose in a strange place as they may be difficult to recapture.

A good method to adopt in dealing with difficult cats is to put the cat on a box, or to



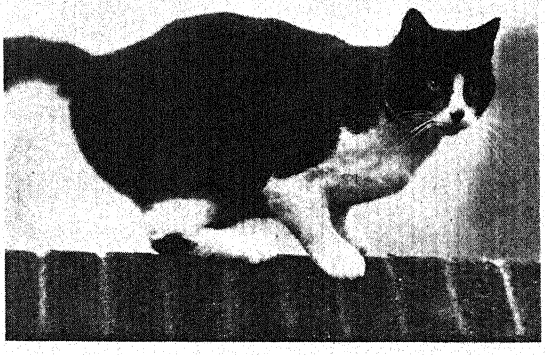
KITTEN CLOSE-UP. Another example of a miniature camera snap. The kitten was held by an assistant and careful attention was given to the lighting

Photo, Thomas Fall : pan. film, 1/50 sec.

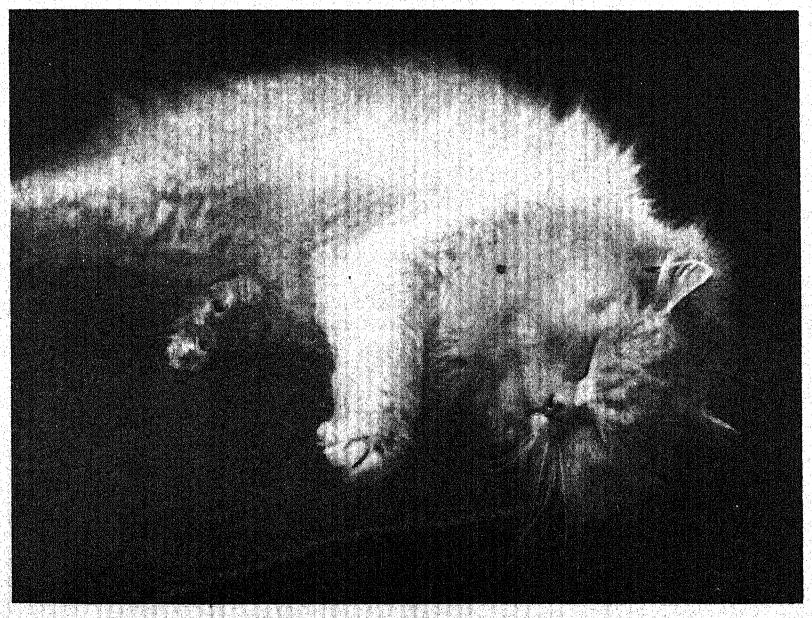


VARIED BACKGROUNDS. The selection of the right material and attention to position and lighting have resulted in this successful study of a tabby cat. Panchromatic film was used to bring out the contrasting markings. Below, two chance shots which show a contrast between good and bad backgrounds. The cat on the wall is clearly silhouetted, while the other picture is spoiled by an unsuitable background

Photos, Thomas Fall







HOME SNAP. An excellent photograph taken in ordinary lighting of a pure white cat. A miniature camera was used

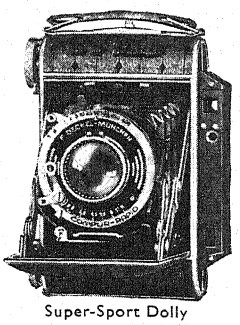
Photo, Thomas Fall, orthochromatic film, 1/10 sec.

hold the cat from behind the box, which should not be much bigger than the cat itself. There should be no cloth on the box for the cat to dig its claws into, but the box should be on a table covered with a cloth. The cat placed on the box should be always in focus. Should it take fright and jump off suddenly, it will nearly always jump on to the table first, digging in its claws momentarily, and this slight pause enables it to be recaptured before it can get away.

This may happen over and over again until the cat is tired out, or gives it up as a bad job and submits. If a cat can be tired out in this way, it is often possible to get half a dozen good pictures in as many minutes. It is better to commence every time with the assumption that the cat is going to be timid and easily frightened by the camera, until experience proves it to be otherwise. Even if the sitter proves to be difficult, and some of the foregoing hints and ideas are carried out, these should become possible, especially if the would-be photographer is prepared to expend infinite patience.

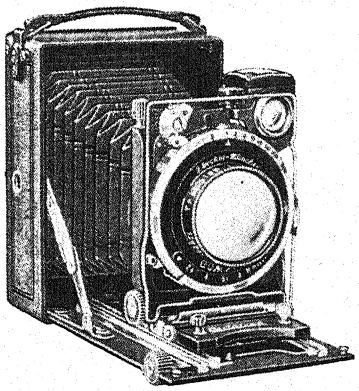
CERTO CAMERAS. Among the German cameras marketed in this country by Actina, Ltd., the "Certo" series of cameras has proved very popular. For the novice there is the Certo Double-Box (*see* Box Camera), taking pictures of either $2\frac{1}{4} \times 3\frac{1}{4}$ in. or $2\frac{1}{4} \times 1\frac{3}{4}$ in. on the same spool. A complementary lens may be inserted between the two halves of the lens system for close-up portraits. The "Certix" models are folding roll-film cameras, which, by a masking device, will take eight pictures $3\frac{1}{4} \times 2\frac{1}{4}$ in., or 16 of half that size, and on certain makes of film 12 pictures $2\frac{1}{4}$ inches square. The "Certonet" is a de-luxe model, with radial-lever focussing and Compur shutter.

A very useful model is the "Super-Sport Dolly," Model C, which is a folding roll-film camera, adaptable, by means of clip-on sides and focussing screen, for use with plates or film-pack. It may be obtained with lenses up to *f*2.8 aperture, and is fitted with a Compur shutter and delayed action release. This camera also allows of spooling back to its correct position a roll-film which has been wound too far.



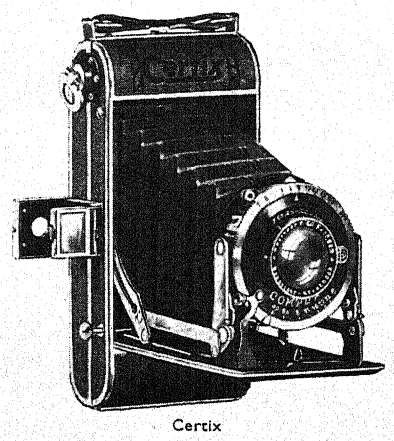
Super-Sport Dolly

The "Certosport" is a folding plate camera, made in two sizes, $3\frac{1}{2} \times 2\frac{1}{2}$ in. or $4\frac{1}{4} \times 3\frac{1}{4}$ in., and is obtainable with lenses of *f*4.5 or *f*3.8 aperture. It is provided with a rack-and-pinion movement to allow of double extension, and the shutter is the well-known Compur S, with delayed action.



"Certotrop"

Another folding plate camera is the "Certotrop," procurable in three sizes: $3\frac{1}{2} \times 2\frac{1}{2}$ in., quarter-plate, and $5\frac{1}{2} \times 3\frac{1}{2}$ in. The smallest size makes use of special quick-action clip-on dark slides. The shutter and lens are easily removable for the quick fixing of special supplementary lenses, while the camera is provided with double extension and rising front. (*See also* Dollina Cameras).



Certix

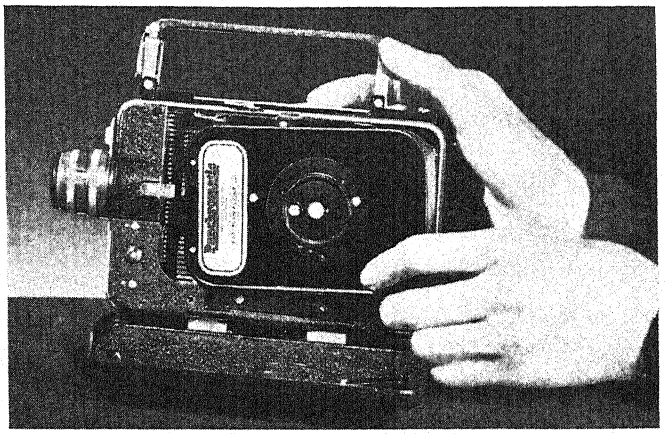
CHARGER. A metal container into which film is loaded for use in charger-loading sub-standard cine cameras. It serves the same purpose in regard to the cine camera as the dark slide does to the plate camera, enabling the film to be loaded into the camera in daylight.

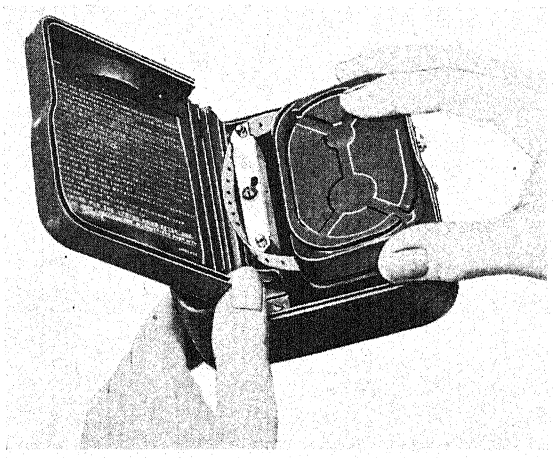
The charger, with one side detachable, has two circular compartments. In the upper the film is placed, emerging through a light-trap to pass behind the camera lens.

After exposure it then passes through a similar light-trap at the bottom and is wound into the lower portion of the charger.

When taking the camera out for a day's filming, it is as well to be provided with a supply of chargers, as normally they hold only 30 feet of film.

The charger itself is loaded in the dark-room. The film is laid in the plain section of the charger and the start of





FILM CHARGERS. Above, film charger being inserted in Magazine Cine Kodak. Reloading is entirely automatic. Left, Pathéscope charger opened to show internal mechanism and film *in situ*

the film attached, by means of a spring clip, to the winding spool. Sufficient film should be drawn from the coil to enable the film to follow the grooves cut in the charger. Care should be taken that no kinks are formed which might lead to jamming.

The charger, even when the lid has been replaced, should not be exposed to a strong light or fogging may occur. When loading the charger into the cine camera, although this operation may be performed in daylight, it is advisable to do it in a shady spot and never in the full glare of the sun. This advice applies even more strongly to chargers loaded with panchromatic stock.

Charging the camera is quite a simple operation. A little of the film should first be withdrawn from the upper part of the charger to make sure that it is moving freely. Then, the claws having been withdrawn from the film guide, the charger is placed in the camera in such a way that the take-up sprocket engages in the winding spool of the charger. Take care that the film is properly within the film guide, replace the gate, and run the film through for a few frames to see that the claws are moving it along as they should. When all is ready the camera door may be closed, the footage indicator placed against O, and the camera is then ready for use.

Should the film become jammed in the charger, the latter should be removed from the camera and, firmly held by the lower chamber, should be knocked smartly on each side so as to level the edges of the coiled-up film, which may possibly be binding against the lid of the charger.

Most sub-standard cinematograph film can be bought either complete in the charger or separately as refills. Certain films, however, are sold in chargers at a price including processing, the chargers remaining the property of the makers. In such cases, of course, refills minus the charger cannot be obtained.

Thus, in the case of the 9.5-mm. moto-cameras marketed by Pathéscope, Ltd., the cost of film is 4s. 6d. per reel, which also covers the charge for developing and the loan of the patented charger in which the film is exposed.

In the case of the Ensign Simplex Pockette 16-mm. camera, a special charger slips into the body in a trice and the film engages itself in the mechanism automatically.

SOME OF THE CHIEF CHEMICALS USED IN PHOTOGRAPHY

NAME	FORMULA	NATURE AND USES
Acetic Acid	$CH_3.COOH$	" Glacial " acetic acid contains about 99% of acid and 1% of water, and this strength should be used in formulae unless otherwise indicated. It absorbs moisture from the air and must be kept tightly stoppered. Acetic acid has a pronounced blistering action on the skin, and any drops spilt on the hands should be washed off immediately. The acid is used in the preparation of clearing, hardening and fixing baths.
Acetone	$(CH_3)_2.CO$	A colourless, volatile and inflammable liquid, mixing in all proportions with water, alcohol and ether, and boiling at 56·3° C. A powerful solvent of fats and resins and celluloid material. It is used in repairing celluloid film, the edges being softened with acetone and then pressed into contact, after which they adhere firmly. Acetone is also used in the making of celluloid negative varnishes.
Alcohol (Ethyl)	$C_2H_5.OH$	" Alcohol " is a generic term, but when used without any form of qualification stands for ethyl alcohol. " Absolute alcohol " (100%) has a specific gravity of 0·794 at 15° C.; " Rectified spirit " contains 10% water; and " Proof spirit " is formed by diluting five parts of rectified spirit with three parts of water. *Methylated spirit* is rectified spirit to which has been added 10% crude wood spirit (to render it undrinkable), together with a small percentage of mineral naphtha, pyridine and a trace of colouring matter. Its photographic uses are for cleaning and rapid drying.
Alum		Term generally applied to crystallized double sulphate of aluminium and potassium, $Al_2(SO_4)_3.K_2SO_4.24H_2O$, which is common alum, or, more correctly, potassium alum, but also covers all double sulphates of univalent or trivalent elements or radicles crystallizing in octahedra and containing 24 molecules of water of crystallization. Alum for photographic use should be free from iron, or prints are liable to be stained. Potash alum is used for clearing baths. Chrome alum, $K_2SO_4.Cr_2(SO_4)_3.24H_2O$, is used in the preparation of hardening baths.
Amidol	$C_6H_3OH(NH_2)_2$	Also known as diamidophenol. One of the best known developing agents, especially for bromide papers. It is readily soluble in water, but the aqueous solution will not keep and should be used at once. (*See* Developers.)
Ammonia	NH_3	A pungent, strongly alkaline gas, best known in the form of a strong solution in water. This has usually a specific gravity of ·880 and contains about 35% of ammonia. It should be kept in well-stoppered bottles. It is used an an accelerator for pyrogallol in alkaline development, and also as a developer in certain branches of colour photography.
Ammonium Bichromate	$(NH_4)_2Cr_2O_7$	Orange crystals made by neutralizing chromic acid with ammonia. Largely used for sensitizing in photo-mechanical processes, and sometimes employed in the place of potassium bichromate in the carbon, carbro and oil processes.
Ammonium Bromide	NH_4Br	White, crystalline powder, soluble in water, chiefly used in photography as a restrainer.
Ammonium Carbonate	$(NH_4)_2CO_3$	Sometimes called " rock ammonia," it usually contains a small proportion of ammonium carbamate, $NH_4.CO_2.NH_2$. Used occasionally for development.
Ammonium Chloride	NH_4Cl	Commonly known as sal-ammoniac. Used in the preparation of chloride emulsions, and in rapid fixing baths.
Ammonium Persulphate	$(NH_4)_2S_2O_8$	Small white crystals, used for reducing negatives. This substance absorbs moisture readily from the air and slowly loses its strength. It should always be kept in a well-stoppered bottle.
Ammonium Sulphide	$(NH_4)_2S$	Made by passing sulphuretted hydrogen through ammonia solution until the gas ceases to be absorbed. Used sometimes for sulphide toning prints.
Ammonium Sulpho-cyanide (Ammonium thiocyanate)	NH_4CNS	Small white crystals readily absorbing moisture from the air. Used for toning P.O.P. It is more correctly termed ammonium thiocyanate.
Amyl Acetate	$CH_3.COOC_5H_{11}$	Sometimes known as Essence of Jargonelle Pears, it is a colourless liquid with a strong odour of that fruit. Insoluble in water, but soluble in alcohol. Employed in the preparation of celluloid varnishes and film cements used for the splicing of broken ends of cine film.
Barium Chloride	$BaCl_2.2H_2O$	Poisonous white crystals, used for making baryta paper (*q.v.*).
Barium Sulphate	$BaSO_4$	Also used in making baryta paper. Synonym: *Blanc fixe.*
Barium Sulphide	BaS	Sometimes used for the sulphide toning of bromides in place of sodium or ammonium sulphide.
Borax Sodium Borate	$Na_2B_4O_7.10H_2O$	Known also as sodium borate or biborate. Made by neutralizing boric acid with soda. Used in some emulsions for papers, in toning P.O.P., and in fine-grain developers. (*See* Buffered Borax *under* Developers.)
Cadmium Bromide	$CdBr_2.4H_2O$	Used in the manufacture of bromized collodion for process engraving and various photo-mechanical processes.
Calcium Chloride	$CaCl_2$	Formed by dissolving chalk or lime in hydrochloric acid and evaporating the solution. The anhydrous salt is a powerful absorbent of atmospheric moisture, and for this reason is placed in receptacles containing platinotype and other papers which deteriorate through damp.
Carbolic Acid	$C_6H_5.OH$	Known also as Phenol, it is not a true acid, but a crystalline substance obtained from the distillation of coal tar. A powerful antiseptic and preservative, it is often added to gelatine and mountants.
Caustic Potash	KOH	*See* Potassium Hydroxide.
Caustic Soda	$NaOH$	*See* Sodium Hydroxide.
Chlor-quinol	$C_6H_5(OH)_2.Cl$	Often called Adurol. Crystalline powder, dissolving readily in water. Energetic and clean-working developer. (*See* Developers.)
Chrome Alum	$K_2SO_4.Cr_2(SO_4)_3.24H_2O$	Common name for " potassium chromium alum." (*See* Alum.)

NAME	FORMULA	NATURE AND USES
Citric Acid	$C_6H_8O_7$	Made commercially by adding chalk to lemon juice, decomposing the precipitate with sulphuric acid, and then evaporating the solution until crystals are left. Citric acid is used in developing, toning and clearing solutions.
Copper Sulphate	$CuSO_4 5H_2O$	Known also as blue vitriol. Used in copper toning (*see* Toning) in the preparation of bleaches for Intensification (*q.v.*) and the Bromoil process (*q.v.*). For copper toning pure sulphate should be used, as the commercial variety often contains iron.
Formalin (Formaldehyde)	H.CHO	A 40% solution in water of formaldehyde, a pungent gas. Extensively used as a hardening bath for negatives and prints (*see* Hardening). Should be kept in the dark in well-corked or preferably stoppered amber bottles, since it slowly decomposes in the presence of light. Formalin is a powerful antiseptic.
Glycerin	$C_3H_5(OH)_3$	Viscous fluid, a by-product of the saponification of fats. Owing to its hygroscopic and non-drying properties it is employed for rendering supple the gelatine coating of papers or film after drying.
Glycin	$C_6H_4.OH.NH.CH_2.COOH$	Paraoxyphenylamidoacetic acid. A white powder, very popular as a developing agent on account of its non-staining qualities. (*See* Developers.)
Gold Chloride	$AuCl_3$	Made by dissolving gold in nitro-hydrochloric acid. Commercial gold chloride is usually a compound of gold chloride and sodium chloride. Used for toning.
Hydrochloric Acid	HCl	Also known as muriatic acid or spirits of salts. Made by decomposing common salt with sulphuric acid. Used in the platinotype and carbro processes.
Hydrogen Peroxide	H_2O_2	Powerful oxidizer and bleaching agent. Sometimes used in weak solution to free prints and negatives of the last traces of hypo.
Hydroquinone	$C_6H_4.(OH)_2$	Also known as Quinol, or di-hydroxy-benzene. Prepared commercially by oxidizing aniline sulphate with potassium bichromate. Extensively used as a developing agent. (*See* Developers.)
Iodine	I	One of the halogen elements, prepared from seaweed. Its compounds are widely used in photography, chiefly in the preparation of emulsions.
Iron, Ammono-Citrate of	$Fe_2(NH_4)_3(C_6H_5O_7)_3$	Made by dissolving ferric hydroxide in acid ammonium citrate solution and evaporating until crystals are left. Used in blue-printing and iron toning processes. There are two forms of the salt—brown and green, the latter being usually preferable.
Iron, Perchloride of (Ferric Chloride)	$Fe_2Cl_6.12H_2O$	Made by passing chlorine over hot iron filings or by dissolving iron oxide in hydrochloric acid. Used for cyanotype paper and for etching copper and zinc plates.
Lead Acetate	$Pb.(CH_3.COO)_2.3H_2O$	Known as " Sugar of Lead." Similar in appearance and uses to lead nitrate.
Lead Nitrate	$Pb(NO_3)_2$	White, opaque octahedral crystals, used for Intensification (*q.v.*) and occasionally in combined toning and fixing baths.
Mercuric Chloride	$HgCl_2$	Known as corrosive sublimate. Used for Intensification (*q.v.*). *A powerful poison*—great care required in use.
Mercuric Iodide	HgI_2	Bright red powder, insoluble in water but dissolving in solution of potassium iodide, hypo or soda sulphite. Used as an intensifier. *Extremely poisonous.* (*See* Intensification.)
Metol	$C_6H_4.OH.NH.CH_3.H_2SO_4$	Sulphate of methyl-paramido-phenol. Used as a developing agent. (*See* Developers.)
Oxalic Acid	$(COOH)_2$	Used in the preparation of potassium and ferric oxalates. *Poisonous.*
Paramino-phenol	$(C_6H_4.OH.NH_2)HCl$	The hydrochloride of paramidophenol, an organic substance derived from aniline. It is a crystalline powder, and is used in the preparation of concentrated developers, such as " Rodinal." (*See* Developers.)
Para-phenylene-diamine	$C_6H_4(NH_2)_2$	An organic substance derived from benzene which is sometimes used as a fine-grain developer either alone or with glycin or metol.
Potassium Alum	$Al_2(SO_4)_3.K_2SO_4.24H_2O$	Chemical name of common alum. (*See* Alum.)
Potassium Bichromate	$K_2Cr_2O_7$	Large orange-red crystals, prepared commercially from chrome iron ore. Used extensively in most photo-mechanical printing processes and pigment processes, also for intensifying and as a bleacher in reversal processes.
Potassium Bromide	KBr	Small white cubical crystals, made by the action of carbonate of potash on bromide of iron. Used as a restrainer (*q.v.*).
Potassium Carbonate	$K_2CO_3 3H_2O$	Also known as Pearlash, Potash, or Salt of Tartar. A deliquescent granular white powder, which must be kept closely stoppered. Used in the preparation of certain developers. (*See* Developers.)
Potassium Chloroplatinite	K_2PtCl_4	Small red crystals, deliquescent, very soluble in water, containing 46% of platinum. Used for platinum toning and in the preparation of platinum printing papers. Solutions should be made in distilled water and kept in the dark.
Potassium Cyanide	KCN	*Extremely poisonous.* White solid, soluble in water. The solution should not be allowed to come into contact with any cut or abrasion of the skin. Used in the making of various reduction and clearing baths.
Potassium Ferricyanide	$K_3Fe(CN)_6$	Sometimes called Red Prussiate of Potash. Deep red crystals, often coated with a reddish yellow powder, which should be removed by rinsing before use. Used for reducing the density of negatives and in the preparation of bleaching baths in the toning of prints. Used also as a bleacher in the Carbro process (*q.v.*).
Potassium Ferrocyanide	$K_4Fe(CN)_6 3H_2O$	Known also as Yellow Prussiate of Potash. Large yellow crystals. Care should be taken with this substance as the addition of mineral acid to a hot solution of the ferrocyanide releases fumes of the poisonous prussic acid gas. Added to some developers to give brilliance to the negative.
Potassium Hydroxide	KOH	A white, deliquescent, strongly alkaline solid, extremely soluble in water. Used in the making of certain developing solutions.
Potassium Iodide	KI	Small white crystals, used in making emulsions and as an ingredient of some intensifiers and clearing baths.

NAME	FORMULA	NATURE AND USES
Potassium Meta-bisulphite	$K_2S_2O_5$	White crystals, which deteriorate rapidly in air. Should be dissolved in cold water, as hot water partly decomposes it. Used as a preservative of certain developers and for acidifying fixing baths. (*See* Fixing.)
Potassium Oxalate	$K_2C_2O_4.H_2O$	Prepared by neutralizing oxalic acid with potassium carbonate. Used as a developer in the platinotype process (*q.v.*).
Potassium Permanganate	$KMnO_4$	Small reddish black crystals, very soluble in hot water. Used as a test for the presence of hypo (*see* Hypo). Can act both as a reducer and an intensifier of negatives.
Pyrocatechin	$C_6H_4(OH)_2$	Also known as catechol and benzocatechin, pyrocatechin is a phenol obtained from guaiacol, a constituent of beechwood creosote. It is used as a developer. (*See* Developers.)
Pyrogallic Acid	$C_6H_3(OH)_3$	Pyrogallol or trihydroxybenzene (its correct chemical names) is not a true acid. Prepared by heating gallic acid. Extensively used as a developer (*see* Developers). Difficult to keep in solution owing to the rapidity with which it oxidizes.
Silver Bromide	AgBr	Employed as a light sensitive salt in emulsions, either alone or combined with silver iodide and chloride. (*See* Emulsion.)
Silver Chloride	AgCl	Used for lantern-plate emulsions and in the preparation of gelatino-chloride P.O.P., and albumen papers.
Silver Nitrate	$AgNO_3$	One of the most important chemicals in photography, being employed for sensitizing paper as well as for preparing nearly all other salts of silver used in manufacture of plates, films and papers. Also used by the process engraver in making wet plates. (*See* Emulsion.)
Sodium Bicarbonate	$NaHCO_3$	Fine white powder, partially decomposing in hot water. Used in hypo baths for fixing self-toning papers.
Sodium Bisulphite	$NaHSO_3$	Fine white crystals, used in making acid fixing baths.
Sodium Carbonate	$Na_2CO_3 10H_2O$	In a somewhat impure form, it is the common washing soda. The pure sodium carbonate is used in the preparation of certain developers.
Sodium Hydroxide (Sodium Hydrate)	NaOH	Caustic soda. Sold in white sticks or powder form. Is strongly alkaline and very deliquescent, and should be kept closely stoppered. Used as an accelerator in development. Should be handled with caution as it may burn the skin.
Sodium Hyposulphite	$Na_2S_2O_3 5H_2O$	Commonly known as " hypo," this salt is usually sold in the form of large colourless crystals, but can also be procured in anhydrous form as a white powder. Universally used as a fixing agent for films, plates and papers. (*See* Hypo.)
Sodium Sulphantimoniate	$Na_3SbS_4 9H_2O$	Commonly called Schlippe's salt. Colourless crystals gradually becoming reddish yellow. Used as a toner of bromide prints.
Sodium Sulphide	$Na_2S.9H_2O$	White transparent crystals, very deliquescent. Used in the sulphide toning of bromide prints. (*See* Toning.)
Sodium Sulphite	$Na_2SO_3.7H_2O$	Used as a preservative and as an accelerator in various developer formulae. Obtainable in crystal or anhydrous form. The latter dissolves more readily. Keep well corked.
Thiocarbamide (Thiourea)	$CS(NH_2)_2$	Organic compound used in photography for the removal of stains from negatives, bromide and gaslight prints, as well as for the toning of lantern slides. (*See* Clearing Baths.)
Uranium Nitrate	$(UO_2)(NO_3)_2.6H_2O$	Yellowish green deliquescent crystalline salt. Used for toning bromide prints warm-black, red or brown. Used also for the intensification of negatives. (*See* Toning: Intensification.)
Vanadium Chloride	$(VO)_2Cl_4.5H_2O$	One of the most useful chemicals for securing green tones on bromide prints. (*See* Toning.)

CHEMISTRY OF PHOTOGRAPHY

J. F. Stirling, M.Sc., A.I.C.

Few photographers (and this includes professionals) will find that none of the information given here is new to them. For this article, when read in conjunction with the sections on *Chemicals* and *Chemical Terms*, contains all that is necessary for the average photographer to know of the fundamentals of photographic chemistry

PHOTOGRAPHY, both in theory and in practice, is based essentially upon the science of chemistry. Its processes and operations, viewed from a technical standpoint, are, in by far the majority of instances, intrinsically chemical ones, and it is mainly in consequence of its close application of chemical principles that photography has progressively advanced from its earliest stages to its present-day perfection.

The main chemical principle underlying the whole of modern photography is that of the sensitivity of certain silver salts, notably the bromide and chloride of silver, to light. The fact that silver chloride darkens upon exposure to light has been known for two centuries or more, but it is only within the last hundred years or so that advantage has been taken of this fact for the production of photographic images.

If we add a few drops of silver nitrate solution to a small quantity of common salt (sodium chloride) solution, an abundant white precipitate of silver chloride is formed.

This, when it is exposed to bright light, particularly if it is in contact with any organic material, such as paper, gelatine, or the skin, will more or less rapidly acquire a violet hue which will become deeper and deeper until the material turns black.

In the preparation of modern plates, films and bromide papers, it is chiefly silver bromide which is used as the sensitive material, for it is many times more sensitive to light than silver chloride. The silver bromide is carefully formed within a solution of highly purified gelatine containing certain soluble salts and small amounts of other compounds which influence its sensitivity. The mixture of silver bromide, gelatine and other compounds, known as an " emulsion," is then maintained at accurately determined temperatures for certain lengths of time, during which the tiny particles of silver bromide increase in size and, in doing so, become more sensitive to light. This " ripening " of the emulsion, as it is termed, is a process which calls for the strictest control, for upon it depends much of the high sensitivity of the emulsion. The emulsion, when properly ripened, is mechanically coated upon plates, films or paper, thus providing our modern sensitive materials.

Sometimes, small amounts of certain dyes are added to the silver bromide emulsion, or, alternatively, the plates or films coated with the emulsion are bathed in dilute solutions of these dyestuffs. In both cases the result is the same. The silver bromide absorbs the dyestuff and, as a result, becomes sensitive to light of certain colours.

Effect of Light Action

What actually takes place when light acts upon silver bromide is not known with any certainty. It is probable, however, that the light causes the particle of silver bromide (which is a compound of silver and bromine) to lose a portion of its bromine. Theoretically, if the light-action were continued, the silver bromide, a faint yellow substance, would lose the whole of its bromine and would become converted into metallic silver.

Actually, however, under conditions of exposure in the plate or film emulsion, no visible change takes place in the emulsion. Despite this fact, however, we know that *some* change has occurred to the light-struck particles of silver bromide within the sensitive emulsion of the plate or film, and it is convenient to imagine these changed particles of silver bromide as forming a sort of invisible image or " latent image."

The process of development merely continues the action of light. When an exposed plate, film or sheet of bromide paper is submitted to the action of a developing substance, the developer attacks the light-struck and consequently changed particles of silver bromide and, removing the bromine completely from them, converts them into particles of metallic silver. Very fortunately, developing agents do not attack the particles of silver bromide which have not been affected by light-action, for if they did, photography by means of our developing methods would be quite impossible.

The Fixing Bath

After the image on the plate, film or paper has been developed, it is subjected to the action of the fixing bath, which, nowadays, invarably consists of a strong solution of sodium hyposulphite. The hypo bath has the property of dissolving out of the emulsion the unchanged silver bromide so that, upon the completion of the fixing operation, the image consists of particles of pure metallic silver embedded in a matrix of gelatine.

Ordinary printing-out paper, or " P.O.P.," as it is termed, contains an emulsion of silver chloride which is allowed to darken to its fullest extent under a negative and, consequently, does not require development. The silver image so formed, however, is not a very permanent one. In order to improve its permanence, and also its colour, it is submitted to the action of a " toning " bath containing a salt of gold. During the ensuing process of toning, a chemical action takes place between the gold of the toning solution and the silver particles of the image whereby actual particles of metallic gold are deposited upon the silver image, thus greatly improving its tone or colour and, of course, increasing its permanence. The normal process of toning silver prints is merely a gold-plating operation. If, however, the process is prolonged, the gold almost completely replaces the silver of the image.

Some printing-out papers contain a salt of gold in their emulsions. These papers

known as " self-toning papers," require merely fixing, the gold being automatically deposited upon the silver image during that operation.

Sometimes a negative may be too dense ; that is to say, the number of silver particles deposited in a given area of its emulsion may be too great. In such cases the negative is treated with a chemical solution, as, for instance, a solution of potassium ferricyanide and hypo or an acid solution of ammonium persulphate, which actually dissolves metallic silver and so, by chemical means, removes the unwanted particles from the negative. Such a chemical process is known photographically as " reduction."

The opposite process of " intensification " is, as its name implies, one by means of which the opacity of the silver image of the negative is increased. Several chemical methods are available for this purpose, one of the best known consisting of the immersion of the negative in a solution of a mercury salt and the subsequent formation of an image consisting of a mercury-silver amalgam.

Photographic processes are not entirely dependent upon the sensitivity of silver salts to light. The well known and very beautiful platinotype printing process consists in exposing under a negative a sheet of paper coated with a mixed solution of an iron and platinum salt. The platinum salt is not very sensitive to light, but the iron salt is fairly light-sensitive. The result of this combination of salts is that the light-struck iron salt converts the platinum salt into metallic platinum when it is wetted with a suitable developing agent, this conversion being exactly in proportion to the extent of light-action on the iron salt. In this manner an image in metallic platinum, an exceedingly stable and permanent material, is readily obtained.

Gelatine Processes

A large number of photographic processes, including the well-known " carbon " process (*q.v.*) of printing, are based upon the fact that when gelatine is treated with potassium or ammonium bichromate and exposed to light it becomes insoluble. What actually happens to the gelatine during this process is not known. We do know from experience, however, that the insolubilizing of the bichromated gelatine proceeds in exact proportion to the extent of its light-action. Thus it is possible to coat a plate of glass with bichromated gelatine, expose it under a negative and subsequently dissolve out the unexposed areas of gelatine, thereby forming a photographic image in gelatine.

If an insoluble pigment, such as lamp-black, is mixed with the bichromated gelatine and the mixture then coated upon paper, the latter then being exposed under a negative, it is clear that the insolubilized gelatine will retain the pigment and will thus give rise to a visible image on the paper. Such is the chemical principle underlying the exceedingly beautiful " carbon " printing process.

Converting the Image

By various chemical methods the silver image of a bromide or gaslight print may be changed into an image consisting of another substance. If, for instance, we take a bromide print and immerse it in a solution containing potassium ferricyanide and potassium bromide, the image will be converted into an almost invisible one consisting of silver bromide. If, now, this silver bromide image is immersed in a weak solution of sodium or ammonium sulphide, the silver bromide will be converted into silver sulphide, a chocolate-coloured substance of great stability. The bromide paper image will thus be " toned " to a chocolate or sepia hue, the process being known as that of sulphide toning (*q.v.*).

Another way of converting an image in metallic silver to one consisting of silver sulphide is to immerse the print in a warm solution of alum and sodium hyposulphite. This hypo-alum toning, as it is called, results in the production of a purplish brown silver sulphide image.

It would be possible to multiply at great length instances of the theoretical principles of chemistry underlying practical photographic processes. Those, however, which have been enumerated above will be sufficient to demonstrate the dependence of photographic principles and practice upon chemical science and to emphasize the necessity of having a working knowledge of the latter in order to comprehend fully the precise significance of photographic theory and technique.

CHEMICAL TERMS USED IN PHOTOGRAPHY

As many of the processes employed in photography are chemical ones, it follows that a considerable number of chemical terms will be met with in the various articles contained in this work. For the benefit of those whose knowledge of chemistry is slight, the following table of common chemical terms used in photography, together with a simple explanation, is included. For a list and brief description of the chief chemicals used in photography *see* " Chemicals Used in Photography " (pp. 266-268). A brief survey of the part played by chemistry in photographic processes is also given in pp. 268–270.

Acid .. .. .. One of a class of substances that neutralize and are neutralized by alkalis, and are compounds of hydrogen whose hydrogen atom or atoms can be replaced by metals, or radicals of a metallic character, the resultant compound being termed a salt. The usual test for acidity is blue litmus paper, which turns red in contact with an acid.

Alkali .. .. A series of compounds whose chief characteristics are that they neutralize acids, and in so doing react with them to form salts. They are highly soluble in water, producing caustic solutions which neutralize acids and turn red litmus paper blue. The common alkaline bases are soda, potash and ammonia.

Anhydrous, Anhydride .. Anhydrous means without water. A crystal with no water of crystallization in it is said to be anhydrous. The anhydride of an organic body is the substance obtained from it by the elimination of water. Thus, sulphuric acid (H_2SO_4) from which the water (H_2O) has been abstracted leaves sulphuric anhydride (SO_3).

Base .. .. .. Substance capable of combining with an acid to form a salt. In inorganic chemistry, bases are usually oxides and hydroxides of metals.

Caustic .. .. Substance that burns or corrodes organic tissue, *e.g.* caustic soda and potash hydroxides (*see* Chemicals). In optics the term caustic is applied to lines or curves where intersecting rays illuminate a surface with doubled strength.

Concentrated .. The term " concentrated solution " is often loosely applied to what should more correctly be spoken of as a saturated solution. *See* Saturation (*below*).

Crystallization .. Process by which substances assume the regular forms known as crystals when they change from a liquid or a vapour into a solid. Crystallization may take place in three different ways: when a liquid holding a substance such as sugar or salt in solution is evaporated, the sugar or salt is left behind; when a molten metal cools, the solid mass becomes crystalline; when a vapour changes directly to solid form in cooling, as the vapour of water, in the form of a cloud, changes to snow. The more slowly the cooling takes place the larger the crystals will be.

Decomposition .. In chemistry, the breaking of a substance into two or more elements, or forms of matter simpler than that from which they are formed. The principal means by which chemical decomposition is brought about are heat and electricity.

Deliquescence .. Property possessed by some chemicals of becoming liquid by absorption of moisture from the air.

Digest .. .. To maintain a fluid mixture for a fairly long period at a state of moderate heat.

Distillation .. Process by which a substance, or constituent of a substance, is converted into vapour and then condensed into a liquid state. The use of distilled water is imperative in many operations in photography, since tap water contains many organic impurities.

Gravity, Specific Ratio between the weights of equal volumes of any substance and of some other substance chosen as a standard. For gases, the standard chosen is hydrogen or air; for liquids and solids, water. Water is at its maximum density at 4°C, and specific gravities of other liquids and of solids are usually determined for that temperature.

Halogens .. .. Name given to a group of closely allied elements: fluorine, chlorine, bromine and iodine. The salts of these elements are known as haloid salts.

Hygroscopic .. Sensitive to moisture. *See* Deliquescence (*above*).

Organic .. .. Term applied to that branch of chemistry dealing with the products of animal and vegetable organisms. The term has become to some extent restricted to the study of carbon and hydrogen compounds and their derivatives.

Oxidization .. Strictly, the changes which result in the formation of new compounds with oxygen. It is, however, extended to kindred changes, such as new unions with chlorine or with some other element.

Precipitate .. Solid rejected as insoluble from a liquid as a result of physical or chemical action.

Saturation .. A solution is said to be saturated when it can dissolve no more of a given substance.

Solution .. .. Name given to a homogeneous mixture of two or more substances. The commonest forms of solutions are liquid. As a general rule solids dissolve more readily in liquids the higher the temperature of the latter, though there are exceptions to this law.

Volatile .. .. A liquid which evaporates rapidly is said to be volatile.

CHILD PHOTOGRAPHY: (1) FOR THE AMATEUR

Bernard Alfieri, Jr.

One of the most difficult, and at the same time one of the most pleasing, branches of the camera art, the photographing of children has a universal appeal ; but the worker, as this section emphasizes, needs to be a psychologist as well as a photographer if he wishes to obtain pictures that are characteristic of childhood as well as pictorially praiseworthy. A second article in this section, by a famous practitioner, Mr. Marcus Adams, deals with the subject from the professional's point of view

See also Candid Photography ; Portraiture, etc.

CHILD photography presents a two-fold problem, first a technical knowledge of the use of a camera, and secondly a psychological study of the subject. One is of no use without the other. A photographer who is capable of exposing perfect negatives under painstaking conditions will probably never have a chance of recording the rapid glimpses of animation which represent the ideal picture of a child, whilst to concentrate on the entertainment of the subject and expect to apply the camera at the critical moment without a preconceived plan of action will usually mean a delay during which all is lost.

Rapid Exposures Out of Doors. Let us first consider the easiest method of obtaining unposed pictures out of doors. Technically, a rapid survey of the existing conditions should be noted. Direct sunshine will cause the subject to screw up the eyes ; very weak sunshine or a strong diffused light is to be preferred. The stage should be set in open surroundings where a slight change of viewpoint will not include unsuitable background matter, and, having gained some rough plan of action, the camera can, within certain limits, be set in advance.

Particularly with very young children, manoeuvring into position is part of the game, the exact opposite to a scene where the child is anchored to a selected position, and told to " keep quite still, ducky, while uncle goes and finds his camera." The next compromise lies between lens stop and shutter speed. The faster the speed of the shutter the larger the lens stop that will be required, resulting in the minimum depth of focus. The miniature camera scores in this respect, due to the very short focal length of the lens, which offers great depth of focus for comparatively large lens apertures ; but given good light, and fast negative material, there should be no difficulty in making rapid exposures. The reflex type of camera can be focussed during preliminary arrangements, and it must be remembered that speed is one of the chief factors of success. A child will soon lose interest if it is expected to enter into the peculiar difficulties of the photographer, and it is far better to persuade the photographer to enter into the spirit of the game and apply the camera as opportunity arises.



TO THE LIFE. This photograph has all the essentials that make a good child study taken in the open-air. There is balance and naturalness in the pose and the diffused background brings the subject into bright relief

Kodak Snapshot

Children at Play. Natural photographs of children at play offer the best chances of obtaining good pictures. This does not mean that the subject or subjects are left to toddle about whilst the photographer rushes around in the hope of getting a viewpoint. The game can be part of the general arrangements, engineered within the range of the



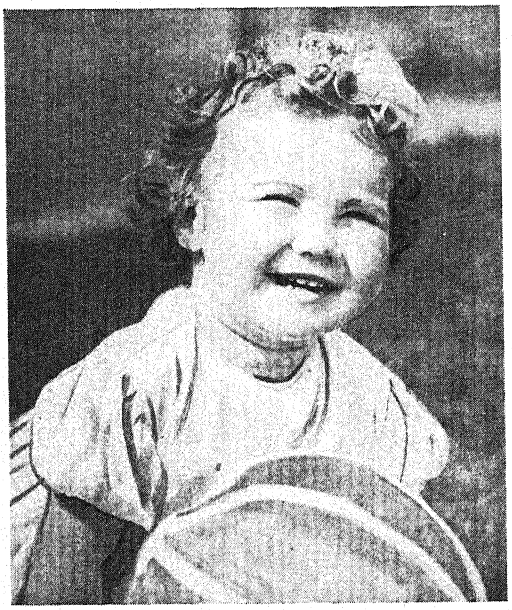
AIRY SETTING. The sky provides a good background in this lively action snap in which there is a pronounced impression of spontaneity and movement. Natural photographs of children at play offer the best chances of success

Kodak Snapshot



NOT CAMERA-CONSCIOUS. In this unposed picture the completely natural attitude of the little bather and the bright surroundings combine in giving a most pleasing "happy holiday" photographic record

Photo, Bernard Alfieri, Jr.



HAPPY SNAP. The long-awaited moment, when a natural smile breaks out on the subject's countenance, after much fruitless effort to procure it, has here been captured adroitly by the patient photographer

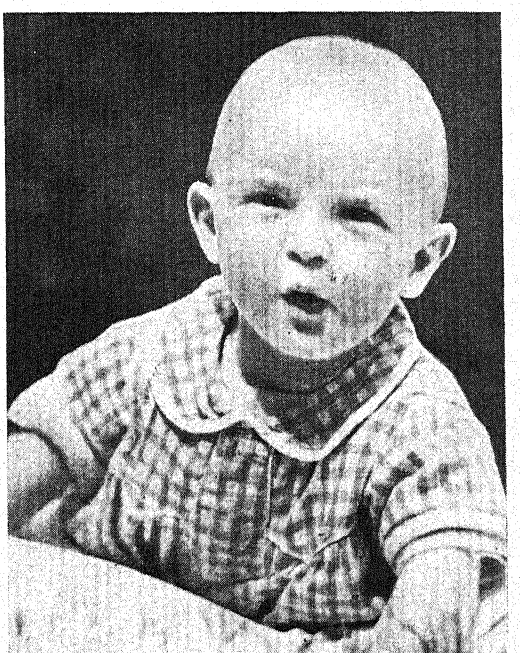
camera, which is the least apparent portion of the setting.

Roughness within gentle limits never fails to appeal. On one occasion when a baby that usually exhibited a pronounced joy in everything at large became bored before the game had really started, her parents acted with great animation, bobbing about, making noises, the photographer performed antics and gyrations which were almost unnoticed, while the cause of all this energy just looked on with strong disapproval. At this stage a hat was placed with some roughness on the baby's head, who immediately pulled it off with screams of laughter ; and when one of the parents ran to pick it up, fresh bursts of merriment greeted a perfectly normal action : nor did repetition fail to increase the fun. During these moments it would have been possible to use the camera on a stand, focus with deliberation, and produce a perfect yell of laughter at almost any given time.

Use of Reflectors. Many photographs of children suffer from poor lighting effects and pronounced shadows which could be avoided by using a reflector. Where, during certain times of the day, the light is practically from the top, a white sheet or other form of white reflector can be employed with advantage. This again does not mean keeping a baby in one position while the best place for the reflector is being determined. For instance, where a young baby is to be photographed, it is often a good plan to spread a white sheet on the ground, place a cushion on top, and play with the sitter on the cushion. In this way there will always be a certain amount of reflected light to balance the direct daylight from above.

In side lighting a white sheet can be arranged on the shadow side for the same purpose, such details being fixed in advance.

Suitable Settings. Many excellent child photographs are spoilt by unsuitable backgrounds and settings. If a dark background is preferred, a large patch of deep shadow will serve, while the sky offers good chances for a light setting. In either case great care should be taken to arrange the subject where conflicting detail will not detract the eye from the main subject. Unobtrusive detail in the background or general setting will help to provide atmosphere ; but there is little scope in child photography to arrange the subject in an exact position required to



WHEN WE WERE VERY YOUNG. Here the interest of a more seriously minded infant than that seen at top has been awakened, and the result is a piece of skilful front lighting and well-disposed background

Photos, Bernard Alfieri, Jr.

fit in with, or avoid, some strong detail matter that may intrude on the general composition.

Slow Exposures. Daylight indoors presents a much more difficult problem. Excellent pictures are often arranged in front of a window, and hard shallow detail is softened either with a reflector or by the use of artificial light, but under such conditions, even with large aperture lenses, comparatively slow exposures are necessary. In practice it will be found that there are moments when even slow exposures can be given, and it is chiefly a question of being in a position to take advantage of any opportunity that may be presented.

Artificial Light. Artificial light in child photography brings its own problems, quite apart from a general knowledge of lamps and their use and application. Assuming that suitable lighting arrangements are available, and have been previously adjusted, a continual glare of brilliant light will produce a strange atmosphere and detract the attention of the subject, even if all attempts to accustom the child to the light do not fail completely. It is better to increase the light slowly rather than switch on suddenly, and better still to be able to arrange the photographs in subdued light, and only switch on the full light at the actual moment of exposure. Some method of synchronization is a great help where available.



BABY STUDY. As an alternative to other arrangements in which the little subject is photographed alone, the "babe-in-arms" pose, as exemplified above, can be adopted with most pleasing results
Photo, Bernard Alfieri, Jr.; Panatomic film, f3.5, 1/40 sec.

Flash-Bulbs. Flashlight, particularly in the form of photo flash-bulbs (*see* Flashlight and Photo Bulbs), offers great possibilities in child photography, and again if the light is synchronized to the camera shutter, rapid exposures may be given. Very flat lighting will be obtained if the flash is arranged immediately behind or attached to the side of the camera, but with practice, and a length of flex, it is possible to arrange quite good lighting effects where the flash-bulb is at an angle to the subject and a reflector is placed on the opposite side. This method gives greater depth to the picture and three dimensions to the subject.

Environment. In child photography a familiar environment is an enormous help. When a child is taken to a professional studio, most photographers spend considerable time in playing with the subject, in a hope that they will become accustomed to the surroundings, before any attempt is made to use the camera. The amateur photographs children in a familiar setting, and half the battle is won before it has begun.



CONCENTRATION. The two children in this snap are giving their undivided attention to the water flowers in the tumbler, with the result that there is an entire absence of self-consciousness in facial expression and position
Photo, R. Moore

Wherever possible a young child should be photographed in familiar surroundings, and as little attention drawn to any alterations as possible. New toys or fresh means of attracting attention are not always advisable, but familiar toys or any method of keeping the mind well employed will be found invaluable.

Suitable Apparatus. After considering the general problems of child photography, it is obvious that good photographs can be obtained with any reliable camera, but some cameras are easier to use than others, while a large-aperture lens is often a big advantage. It is quite impossible to name any one camera as being best for this type of work, but, on the other hand, the ideal camera must be one that can be used with rapidity and offers the minimum delay in setting.

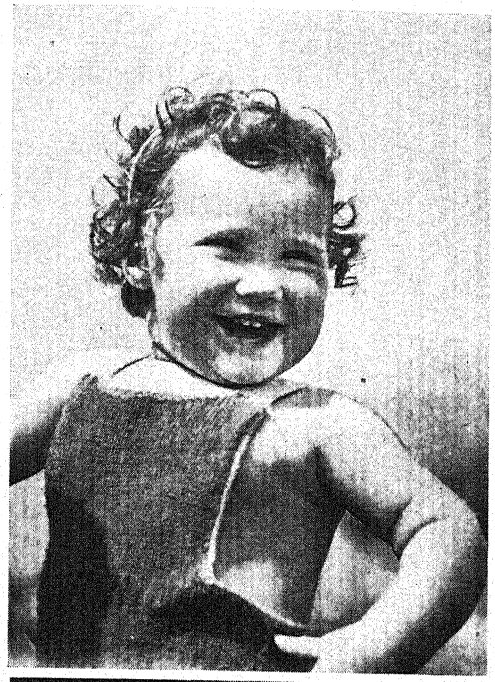
A miniature camera answers most requirements, with the added advantage of combining large lens apertures with the maximum depth of focus. Cameras of the reflex type are convenient for rapidly composing a picture, and are preferred by many workers. A reliable view-finder is essential, and preference should be given to a finder large enough to allow the photographer to visualize the picture instantly, without having to screw up the eye in an effort to look through a small opening, or to require hand shading before the subject can be seen. A cable release is an advantage, especially when making moderately long exposures with the camera on a tripod, and if an exceptionally long cable release is available it is often helpful to wander away from the camera and still be able to make an exposure from any near position. By doing so the child may be made to turn its head naturally to some desired angle. For most child studies a lens of normal focal length covers general requirements, particularly when using a camera not smaller than quarter-plate, as it is easier not to try to fill the negative, in case the subject happens to move at the last

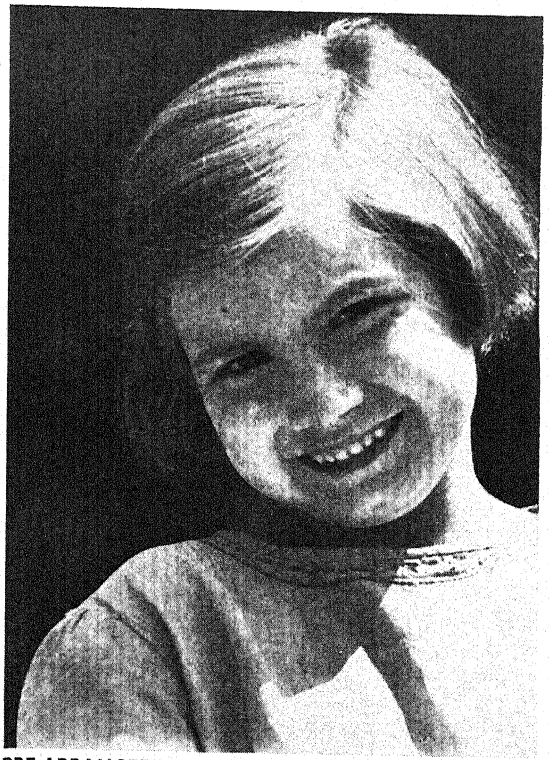


SEMI-SILHOUETTE. A seaside picture which serves to show how a simple background concentrates the interest on the subject. A crowded background would spoil the design and detract considerably from the general effectiveness
Photo, K. Reitz; Zeiss Ikonta

SPONTANEITY. A natural joyousness such as has been recorded below is more than difficult to obtain by "studio" means, and only the inspiration of the moment could yield such a charming study

Photo, Bernard Alfieri, Jr.





PRE-ARRANGED POSE. In the photo above the photographer has relied upon well-arranged side-lighting and a dark background to obtain a sunshine effect ; that the subject has been posed is seen from her slightly forced smile

Photo, Bernard Alfieri, Jr. ; Reflex, 1/50 sec., f4.5, s.s. pan. film



STORY SNAP. Here again "studio" methods have been adopted, but without any loss of naturalness, since the attention is concentrated on the "story" told by the picture rather than on any characteristic of the sitters

Kodak Snapshot



VIEWPOINT AND PERSONALITY. Here is an example of a child photograph in which a low viewpoint has been used with success. The picture is also noteworthy for the excellent gradation and soft tones of the background
Photo, Ilford, Ltd.; Selo pan. roll-film

moment, and an ample surround will not mean such accurate centring.

On the other hand, particularly when using a miniature camera, the subject should fill the negative as far as practicable, and interchangeable lenses will be very helpful.

A moderately long focus lens can be used with advantage for head and shoulders and general close-up studies, and with a miniature camera the focal length of such a lens is still short enough to offer as great a depth of focus as a normal focal length lens on a larger camera.

A supplementary lens, sometimes known as a portrait attachment, can be purchased for use on many cameras. With cheap cameras of the fixed-focus variety, this is the only means of getting near enough to the subject for close-up work; but with many cameras such lenses only allow the camera to be used very close to the subject, and are the cause of bad distortion. The closer the camera approaches the subject the more pronounced distortion becomes, and such attachments should only be used with discretion, and are not to be compared with the effects of a long-focus lens, that will produce an image of the same negative size with the camera much farther away from the subject.

Sensitive Material. Almost any rapid plate or film can be used for child photography, but preference should be given to panchromatic material, not only because good colour correction is obtained in this way, but also because panchromatic films or plates offer a much more pleasing rendering of the flesh tones and produce softer detail in the whites. If plates are used, the "backed" variety is preferable to avoid halation, but with modern films the question of halation is practically non-existent, and many films are provided with some form of backing which disappears at the time when the negative is developed, and is not even noticed by the average user.

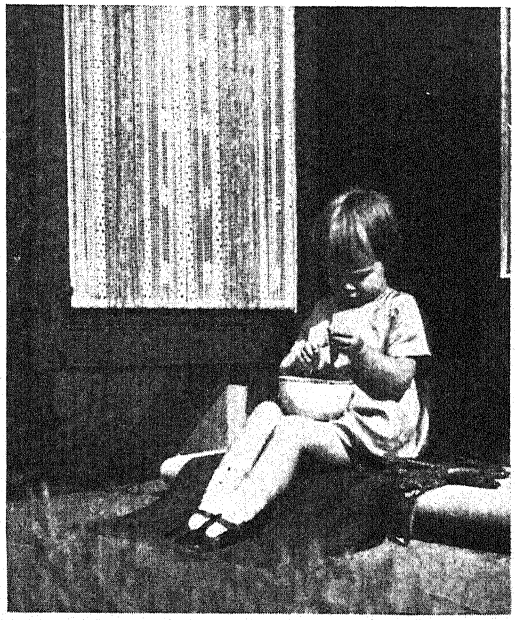
Methods of Posing. Although children are practically free from any form of camera consciousness, it is rarely possible to arrange

a child and light the face as might be done when photographing adults. Even if they keep still they usually show a degree of boredom, and if they submit with unusual patience the result is so unlike the general impression of a child bursting with the joy of living that the photograph would not convey the subject; but, on the other hand, some form of pose makes the photographer's work much easier, and much can be done in arranging a baby on a cushion, within certain limits, or playing with an older child on a rocking-horse, or some other suitable substitute for a chair, which will confine the action within reasonable focal limits.



JUNIOR MODEL. Although the child was specially posed for this picture, the photographer has succeeded in recording a very natural atmosphere. This photograph appears with additional features in p. 287

Photo, Bernard Alfieri, Jr.



SUNSHINE SNAPS. An unposed photograph taken by normal lighting out of doors with the little sitter unaware of the camera

Photo, E. C. Mansell; Selo film, 1/25 sec.



ARTIFICIAL LIGHTING. This scene of a children's tea-party was taken under conditions when artificial lighting was necessary. Sharp focus and large lens aperture are essential in such picture making

Rolleicord, Agfa s.s. pan. film, f4.5, 1/25 sec.

Even quite energetic forms of amusement can be centred round a pre-selected spot, and with children repetition seldom prevents the same, or even greater, enjoyment each time the climax has been reached, especially if the fun comes from a good game.



'THE ENGLISH BOY.' The work of one of the most distinguished child photographers, this studio portrait displays a masterly handling and perfection of treatment which result in an instant appeal. The pose, subtle tones and complete harmony make it an arresting example of photographic art

Photo, Marcus Adams

CHILD PHOTOGRAPHY: (2) PROFESSIONAL

Marcus Adams, F.R.P.S.

Past President of the Professional Photographers' Association

Here, by a leading artist and expert in the professional field, is an interesting sidelight on the subject of child photography. The problems discussed closely resemble those of the amateur, considered in the preceding article, and an instructive comparison may be drawn between the different solutions prescribed by Mr. Alfieri and Mr. Adams

ANYONE with a camera can take a good picture of a child in these days of modern apparatus and materials, for they are almost foolproof. But those who are seriously inclined to specialize in child photography and are determined to succeed in obtaining satisfactory results, must first experiment exhaustively. First take your child sitter, choose a position in your garden and test out several makes of films or plates, making careful notes of the light, such as a grey day or sunny time of day and position of the sun. After you have made a few exposures, change your position in the garden and make a few more exposures. Note what aperture you are using and the length of exposure. With a supersensitive film with *f*8 aperture and 1/25 or 1/50 sec. exposure on a fair day there should be a fair chance of success. After this experience, develop and print to see the results. In further experiments vary your conditions of stop and exposure, keep to the same speed film and test further rolls until you have found a fair basis to work upon.

Practice Makes Perfect

Do not attempt anything but just an ordinary simple portrait, taking your time over the sitting. Do not expect to produce professional-seeming results until you have the requisite knowledge of the handling of your camera. This must become instinctive, and only with numerous experiments and many failures will you become, so to speak, part of your equipment and gain the confidence that will put you in a position to begin another stage of advance. You will be able to give more attention to your subject and less to the camera, and secure a more vigorous result.

When watching experts, you may think there is something of carelessness in their methods. But this is a part of the secret to success, for a person fussing with apparatus and details will never succeed in gaining the child's confidence. Confidence backed with understanding alone creates this casual method that allows the worker to identify himself with his subject mentally.

Choice of Camera

It matters not whether a large or small camera is used, as long as all its tricks and its possibilities are known. Many use a miniature camera. In the latter case, considering its minute size, one must have an instrument capable of giving a negative of a very fine grain to stand the strain of big enlarging. Such instruments are very expensive, and unless the beginner feels inclined to spend a lot of money for the best, he had better content himself with a half-plate, quarter-plate, or $3\frac{1}{4} \times 2\frac{1}{4}$ in. size—or even as small as $2\frac{1}{4} \times 2\frac{1}{4}$ in. This will give more latitude as far as negative quality, while on the other hand the miniature camera gives more latitude for getting unusual positions with a great depth of focus. As regards the details and difficulties of " miniature " technique, there are on the market today some really wonderful exposure meters that will work out the problem of exposure to a very fine point of correctness.

If one can be used it will save many disappointments, but in child photography the worker must be careful not to make a lengthy process or display, as it might create a mental disturbance in the child, which will suspect trickery. I do want to emphasize the point that one must not distract the child by any complicated actions, as in testing. Remember, the child has no knowledge of the process of photography and merely concludes you are playing a trick on it which it will not like. It cannot be too often emphasized that it is the sitter that is most important.

To sum up, there are three fundamentals necessary :

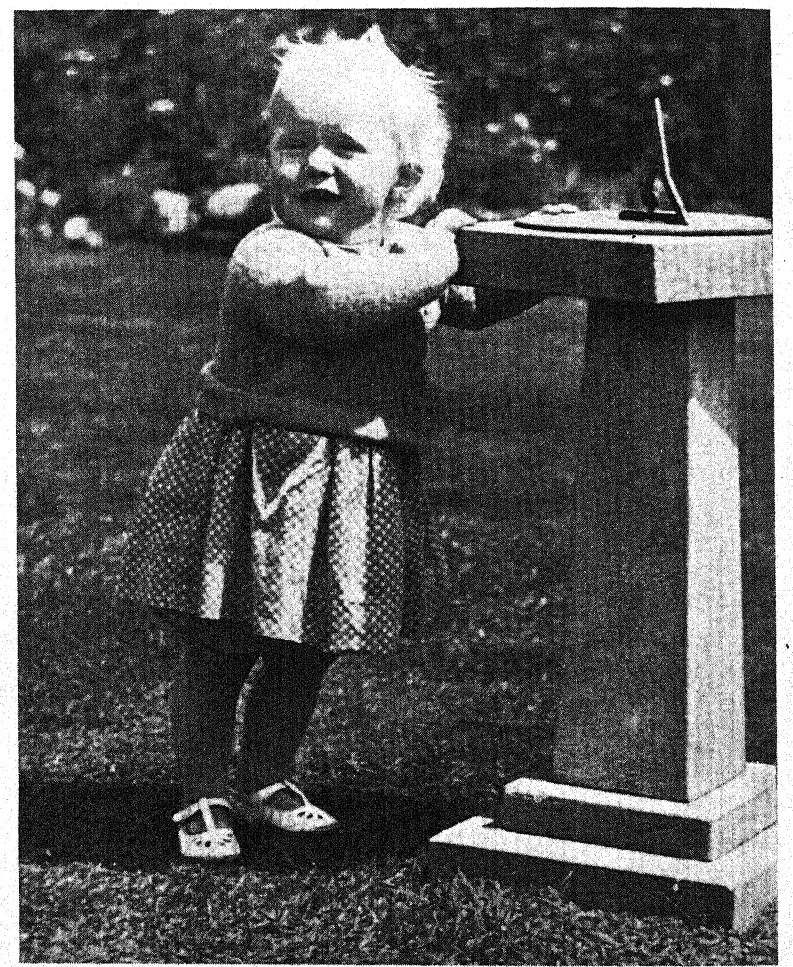
(1) Knowledge of photography.
(2) Knowledge of your subjects.
(3) Knowledge of art.

This last is of the greatest importance ; an artistic sensitiveness of feeling is the greatest gift one can have in dealing with child photography.

No. 1 you acquire by practice and failures. For No. 2 you must understand children well —their moods, mentality, and actions under many conditions. No. 3 is a quick mental response and sensitive, impulsive appreciation of every detail of the photographer's art, such as pattern, composition and a keen sense of tonal values. This is all the more necessary since the most difficult subject in all photography is a real live child, a subject full of life, but not always reasonable in outlook. It is no good to talk to your sitter or to tell him to sit still, or you will find that his strict obedience is fatal to a natural picture and you will never overcome the difficulty you have yourself formed by telling the child what to do. All the time your aim must be to induce and not command the subject to give you what you know they are capable of giving.

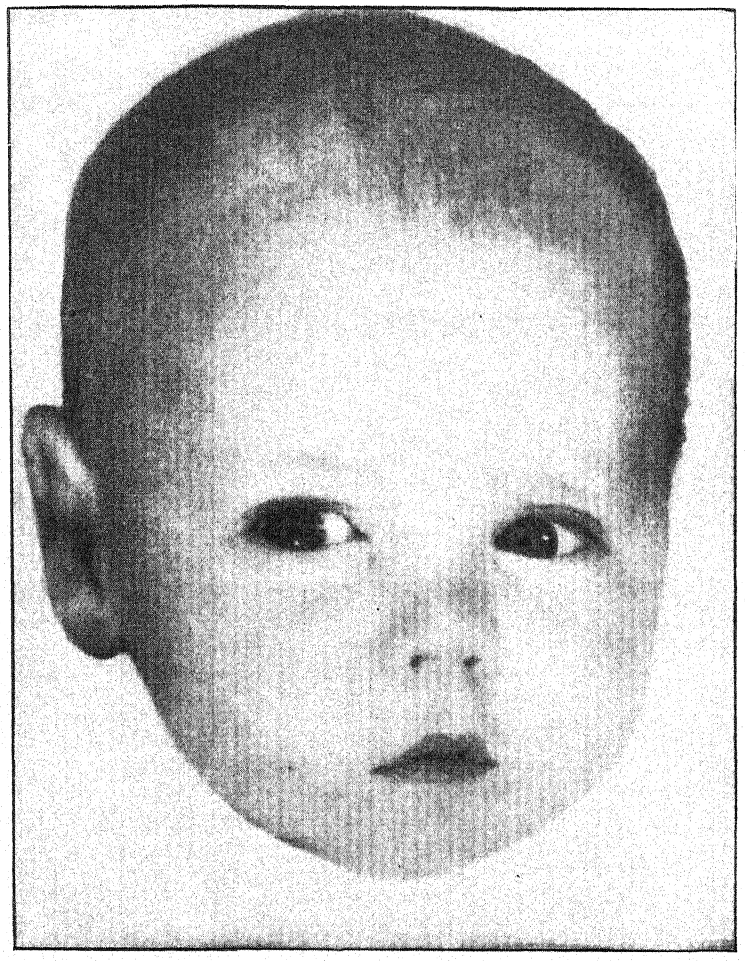
Beyond taking a record, to be of any value the picture must represent the true life and character of the little subject ; and the little personality is so influenced by all its surroundings that often it is extremely difficult to get records without reflecting the conditions of the operation in the expression of the child. Children are mirror-like, so that the worker must not permit himself to be reflected through its mind and so spoil the characteristics of that child. It must not be forgotten also that most children are mimics, and many of them very clever mimics. It may be asked, what has this to do with a photograph of a child ? In my mind it is everything, the Alpha and Omega of the real likeness of the real child. You must be so sensitive to these subtle differences that your pictures will reflect them.

" Don'ts " for Child Photographers. A few don'ts on backgrounds : Don't place your subject too close to the background unless it be a light wall, when the child's



GARDEN SNAP. A good portrait negative must possess a continuous tone gradation so that attention to lighting is of primary importance. In this photograph the child has been placed so that the sunlight gives just the right effect of delicate light and shade

Photo, H. B. Burdekin ; Contax, f6.3, 1/50 sec.



ACTUALITY IN THE PORTRAIT. Child photographs are so often restricted to broad smiles and delighted hilarity that a study of a serious moment such as this has the charm of rarity. From this professional masterpiece of skillfully controlled development and printing amateurs may learn much-needed lessons

Photo, Marcus Adams

figure will create an interesting shadow on the wall's surface.

Don't use a brick wall unless it be an *old* one broken up with age.

Don't use corrugated iron or a laurel or ivy-leaf hedge, or trellis work with the sun forming a moving set of shapes with the leaves.

Don't take your child with the sun at its back and the camera facing the sun; this spoils the quality of the flesh tone unless there is a vast amount of reflected sun on its face.

Lastly, be very careful as to your background; the whole effect is made or marred with the background. While judging big newspaper competitions I have seen thousands of wonderful pictures of children spoiled with bad backgrounds. Well-selected spots are to be found in the most unlikely corner. I well remember a farm at which I stayed in South Wales; at the back of the house was a covered-in wash-place, with one end open forming a darkish, mystery background, while at a certain time of the day the sun shone on a newly whitewashed wall. With the surrounding open space and the reflected light, this background was ideal for picture making. Often in a beautifully kept garden one finds it difficult to find an ideal spot. I have often spent an hour or so searching for a three-foot space with a light that would render the flesh with a luminous quality, and not make the tones over the face too contrasting. When you understand the conditions you want, you can create your own studio with a sheet and sacks.

When photographing children at the seaside be careful not to get some small child in the distance, maybe out of focus, or standing on the head of your subject, or maybe someone sitting in a deckchair right across the picture.

Indoor work is similar to outdoor, but the worker will encounter more difficulties—with windows or spots of limited light. These, of course, curtail the possibilities and increase the exposure, double or treble, and increase the liability of black faces. Should you decide to use the skylight at the top of the house, you will create too deep

a shadow in the eyes; and as the eyes are generally the most attractive features of the child, this must be avoided.

Apparatus. A word regarding apparatus. This is a personal matter of likes and dislikes. I cannot, of course, express preference for any particular make of camera, but my own experience leads me to recommend especially a Taylor, Taylor and Hobson lens, or Zeiss Tessar or Ross Xpres; the last, to my mind, has a really wonderful quality of its own, with apertures ranging from *f*4.5 to *f*1.9. But there are many makes of really high speed and quality today.

As for cameras, I cannot personally use the miniature camera, having had too long experience with larger cameras. I find my mind is limited to the $2\frac{1}{4} \times 2\frac{1}{4}$ in., which I feel affords the opportunity of more exceptional pictures. But when one gets to a more serious stage one finds that two or three different cameras are most useful; for instance, for quick motion pictures an exposure from 1/50 sec. to 1/300 sec. will be needed. Do not mind wasting plates or films; you must run risks if you would obtain the best. Therefore, be generous with material, remembering that with children's work all the odds are against you.

The one hundred and fifty thousand children who have passed the front of my lens have taught me much tact and more patience, and have adjusted my mind to a very keen sensitiveness of all the happenings that pass through the mind of the child.

CHLORO-BROMIDE PRINTING. A chloro-bromide emulsion contains a mixture of silver bromide and silver chloride. Papers coated with this (called chloro-bromide or C.B. papers) are slower than bromide but more rapid than gaslight papers, and are among the most beautiful media for the production of warm tones, giving a range of colours from warm or brownish black to rich brown. This range is obtained by adjusting the exposure time and developer, and such fine gradations result from individual adjustments that probably no two workers could produce identically the same results. The mastery of chloro-bromide printing is thus a fine art, and depends mainly on the tastes and capabilities of the individual.

The first essential is a negative of exactly the right kind, for subjects of high or low contrast (*i.e.* with very few intermediate tones between lightest and darkest) are not suitable for work with these papers. A long scale of tone gradations in a fully exposed negative is essential. Most makes of C.B. papers are available in two speeds, rapid and normal: the former is intended for big enlargements, and the latter for contact work.

To discover the tones available a test print should be made, using always a yellow safelight. Exposure should be made at about 3 feet from an electric or gaslight, exposing first the whole of the negative for 5 secs. With about a quarter of the area covered another 5 secs. exposure is made; with another quarter covered, another 5 secs., and so on. This test print must now be placed in the developer, which must be between 65° and 70° F, 68° being the best temperature. In order to obtain a warm-black tone, from $2\frac{1}{2}$ to 3 mins. development is needed; after rinsing for 2 or 3 secs. the fixing bath follows.

Such testing will illustrate the worker's personal capability and the particular qualities of the paper used. When once these have been discovered the same paper should be adhered to. It will probably thus be found that a warm-black image was obtained with a 10 secs. exposure and $2\frac{1}{2}$ mins. development at 68° F.

For Warm Images. To obtain a much warmer, or brown, image, five times the exposure should be given with development for one-half the original period—or, better, the use of diluted developer, with, possibly, the addition of extra restrainer. Warmer colours still are obtainable by extending the time of exposure and curtailing that of development. The same rules hold good for enlarging.

Fresh developer must be used for each print, all solutions being kept at the same temperature. Total time for fixing must not exceed 10 mins., with, preferably, two baths of 5 mins. each. The image of a chloro-bromide print consisting of exceedingly finely divided silver, a long immersion in a fixing bath—especially an acid one—may remove some of the silver in the high-lights and thus impair the quality of the print.

For general use and for warm-black tones the following developer is satisfactory,





Contact print of subject enlarged above

PENSIVE INTERLUDE. Simplicity and naturalness form the salient characteristics of a child's personality, and in this photograph these have been recorded with remarkable clarity

Photo, W. G. Briggs, F.R.P.S.; Leica f3.5, 1/40 sec., Agfa Isopan F film

though that recommended by the maker of the paper should be used when possible:

Metol	10 grs.
Hydroquinone	40 grs.
Sodium sulphite (crys.)	600 grs.
Sodium carbonate (crys.)	450 grs.
Potassium bromide	30 grs.
Water up to	20 ozs.

For use dilute with equal volume of water.

For colours from warm-brown to brick-red the following developer may be used:

Sodium sulphite (crys.)	1 oz.
Sodium carbonate (crys.)	1 oz.
Potassium bromide	16 grs.
Chlorquinol	60 grs.
Water up to	20 ozs.

For warmer tones dilute with equal volume of water, increase exposure and use more bromide.

The fixing bath is made as follows:

Hypo	3 ozs.
Potassium metabisulphite	½ oz.
Water to	20 ozs.

After fixing, prints should be washed for half an hour—or for thick paper, one hour—in running water.

Chloro-bromide papers may also be used for obtaining cold tones, in which case a paper with a white base is used and the amidol developer given below. These are especially valuable for such subjects as snow scenes, and the cold black image is of first-rate quality.

Amidol	50 grs.
Sodium sulphite (crys.)	500 grs.
Potassium bromide	2 grs.
Water to	20 ozs.

Exposure should be regulated so that development is complete in 2 to 2½ mins. at 68° F.

CHRISTMAS CARDS BY PHOTOGRAPHY

A useful adaptation of photography is described by Mr. Bernard Alfieri, Jr., in the following article, in which suitable subjects and the method of mounting them for "seasonable greetings" are described in practical fashion

Photographic Christmas cards produced from personal negatives offer a special appeal as a means of greeting friends. Each year, plain cards with simple lettering are available, which can be used for mounting small prints, or any good quality card can be folded to answer the same purpose, although bromide paper itself makes an attractive base on which the photograph and design can be printed, particularly where it has been cut and folded to form the cover, and a simple greeting added, either to a separate sheet inside, or photographically on the bromide paper.

It will be found that a sheet of bromide paper 10 × 8 in. cut lengthways and folded in the centre will form a particularly useful size, either with a strip picture covering the whole surface, or a front subject only, size 5×4 in. Double-weight paper in one of the many art surfaces is to be recommended, and where the back portion has been left plain it sometimes helps the general effect to fog it slightly from one corner, producing a pleasing shading effect and offering a contrast to the picture side. Obviously, single cards of any size can be used.



AN ADAPTED PHOTOGRAPH. A pleasant change from the inevitably recurrent robins, stage-coach and holly as Christmas card subjects, yet one which is seasonable, is shown above. How to prepare Christmas cards from photographs is described in the article beginning in this page

Photo, Bernard Alfieri, Jr.

Printing by Enlargement. Where white lettering is wanted on dark portions of the photograph it is quite easy to cut a piece of tracing paper, or tissue, the same size as the bromide paper and, projecting the subject in its correct size, add the wording with a black pencil on the tracing paper. The bromide paper is preferably placed in a printing frame or under glass, so as to make good contact with the tracing paper, and the

exposure is made through the latter. If the lettering comes in the sky portion of a landscape, as in page 286, it may be necessary to shade the sky or slightly fog the paper in order to obtain sufficient background tone to make the lettering stand out.

Contact Printing. Where the subject size on the negative lends itself to contact printing, the negative can be placed behind tissue, as for enlarging, or it can be bound up with a piece of plain negative glass, on which designs or lettering have been worked, and exposed in a printing frame.



SEASONABLE GREETINGS. Above, the photo reproduced in page 279 has been transformed by the addition of appropriate lettering copied from an old Christmas card
Photo, Bernard Alfieri, Jr.

Copy Lettering. For those who do not wish to do the lettering, an easy method is to choose appropriate lettering on any printed card and make a copy negative, blocking out surrounding matter. The subject exposure is first made, either by contact or enlarging, and then the lettering is printed on top, as shown at the left as a simple example of black lettering on a white ground. If white lettering is required on a dark ground, and no suitable white lettering is available, dark letters can be photographed as already described, and a contact transparency made, preferably on a contrasty process plate, and so long as the plate shows black on a clear ground it may be bound up with the subject negative and enlarged together as illustrated in the opposite page.

Where the lettering is permitted to encroach on the subject it will help in giving it the appearance of a single whole, rather than the effect of adding the word incidentally.

CHURCH AND CATHEDRAL PHOTOGRAPHY

Bernard Alfieri, Jr., and R. S. Illingworth

Churches and cathedrals abound in attractive and valuable subjects for the photographer : screens, pulpits, reredoses, misericordes, choir-stalls, bench-ends, fonts and monumental brasses. Hundreds of carvings, in wood and stone, lend themselves to picture-making at every season of the year

See *also Architectural Photography*

THERE is scarcely a town or village throughout the country that is without its old church ; we use them, or pass them by often without eyes to see the beauty that lies within, or the pictures that are there for the taking.

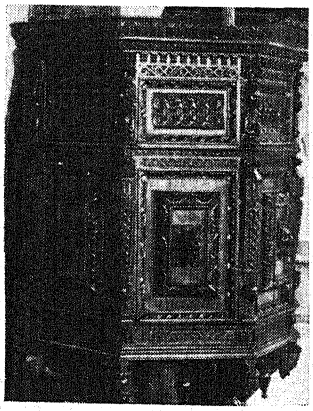
For hundreds of years many of our old churches have stood against the advance or destruction of modernism, their old walls and timbers, that survived civil war and religious intolerance, still in a state of good preservation. They offer subjects teeming with historic interest and pictorial expression, and are tributes to the hands that built them. Their construction and the detail found within tell of bygone generations and customs of the past, and the beauty of their architecture offers unlimited scope for every type of camera.

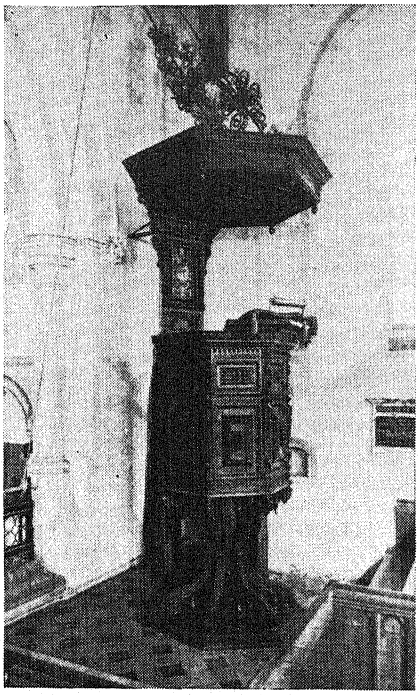
Where interior views often necessitate the use of a wide-angle lens, or a camera with rising-front or swing-back to enable vertical lines to be rendered upright and parallel, there are often picturesque corners in the old churches that can be recorded with even a simple box camera. The subject, however, is too extensive to cover with any one camera or lens, but pictorial material is available for all.

Sometimes if the interior is very dark it may be necessary to give a very long exposure, half an hour, or even an hour ; but such time can be spent in arranging the next shot, determining the best point of view, and

visualizing the composition. It is a subject that cannot be hurried, and the amateur who wants to expose his films quickly had better look elsewhere.

Frequently the lighting conditions in a church produce strong contrasts. There may be a light source, such as a window, included in the picture that will over-expose rapidly, and also dark portions where the maximum exposure is necessary, and for this reason, when the general lighting is very dull and poor, it is wise to use fast negative material, preferably panchromatic. If plates are used, they should, of course, be backed.





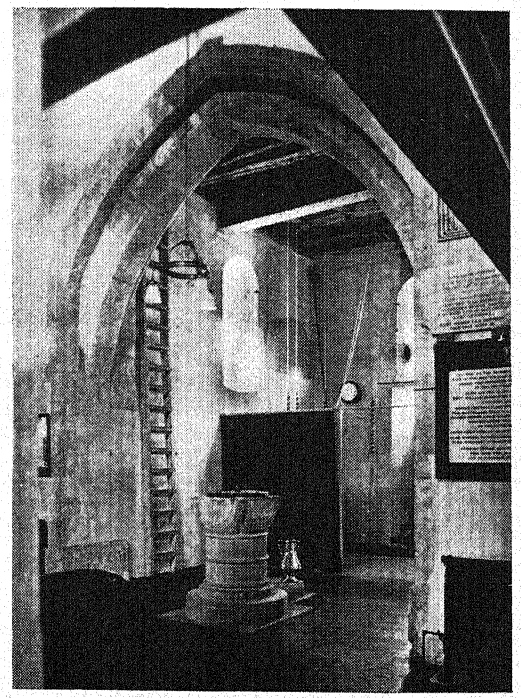
PULPIT FROM TWO ANGLES. Above is a distant view of the fine old seventeenth-century carved pulpit at Stoke D'Abernon Church ; on left a close-up of the pulpit, showing detail of the carving *Photos, Bernard Alfieri ; above : 30 mins., f16, s.s pan. film*

Where the lighting is of this character, it is better to over-expose and rely on making the prints on a contrasty grade of printing paper, rather than to under-expose and get a negative devoid of all detail in the shadows. With fast panchromatic material, however, many exposures can be shortened considerably to three minutes or less, according to the stop used in the lens.

Reflections on polished brass work, or direct light from a window in the lens of the camera should be watched for ; the latter can often be avoided by choosing a position behind an outstanding pillar, or arranging a shadow beyond the range of the lens hood (which should always be used on the camera for this work). It is better to risk cutting off a portion of the picture than to spoil it all by letting a direct ray of bright light fog the negative.

Most churches possess a guide or printed history that can be obtained for a few pence, and few clergymen will refuse permission to use a camera to any bona-fide amateur photographer ; in fact, one can usually obtain the greatest assistance from the vicars of these churches, who often show an enthusiasm which may result in some of the pictures being reproduced in the church magazine.

If the photographer has a pronounced interest in church construction, decoration and the significance of details, he can often obtain suggestions from other church attendants, and may find carvings otherwise hidden to the occasional visitor.



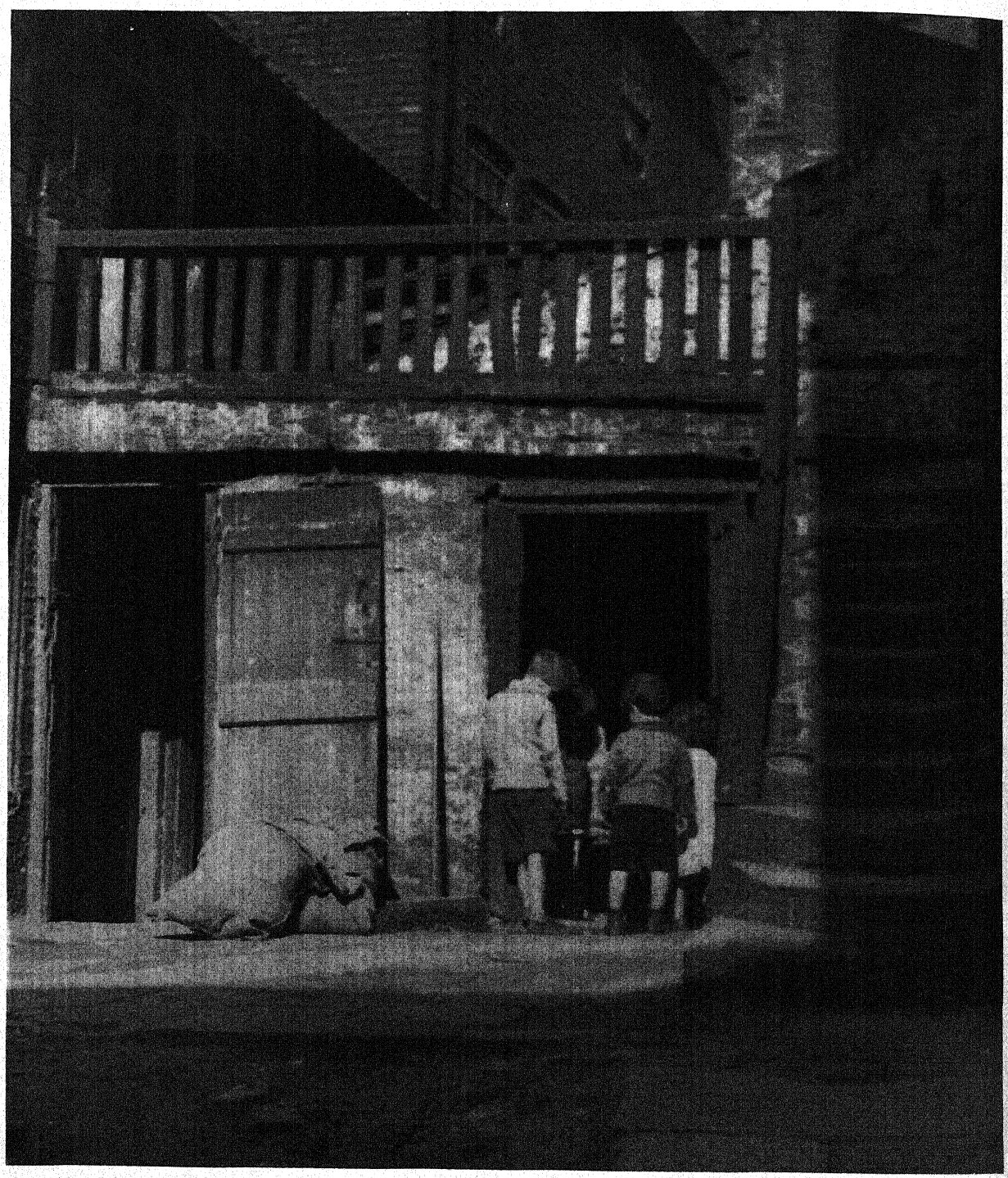
ARCHITECTURAL STUDY. Fine view of the old Norman tower and Saxon font at Thames Ditton ; here the viewpoint has been well chosen and the lighting perfectly adapted *Photo, Bernard Alfieri ; 10 mins., f16, pan. film*



THE BRIDESMAID

Marcus Adams, F.R.

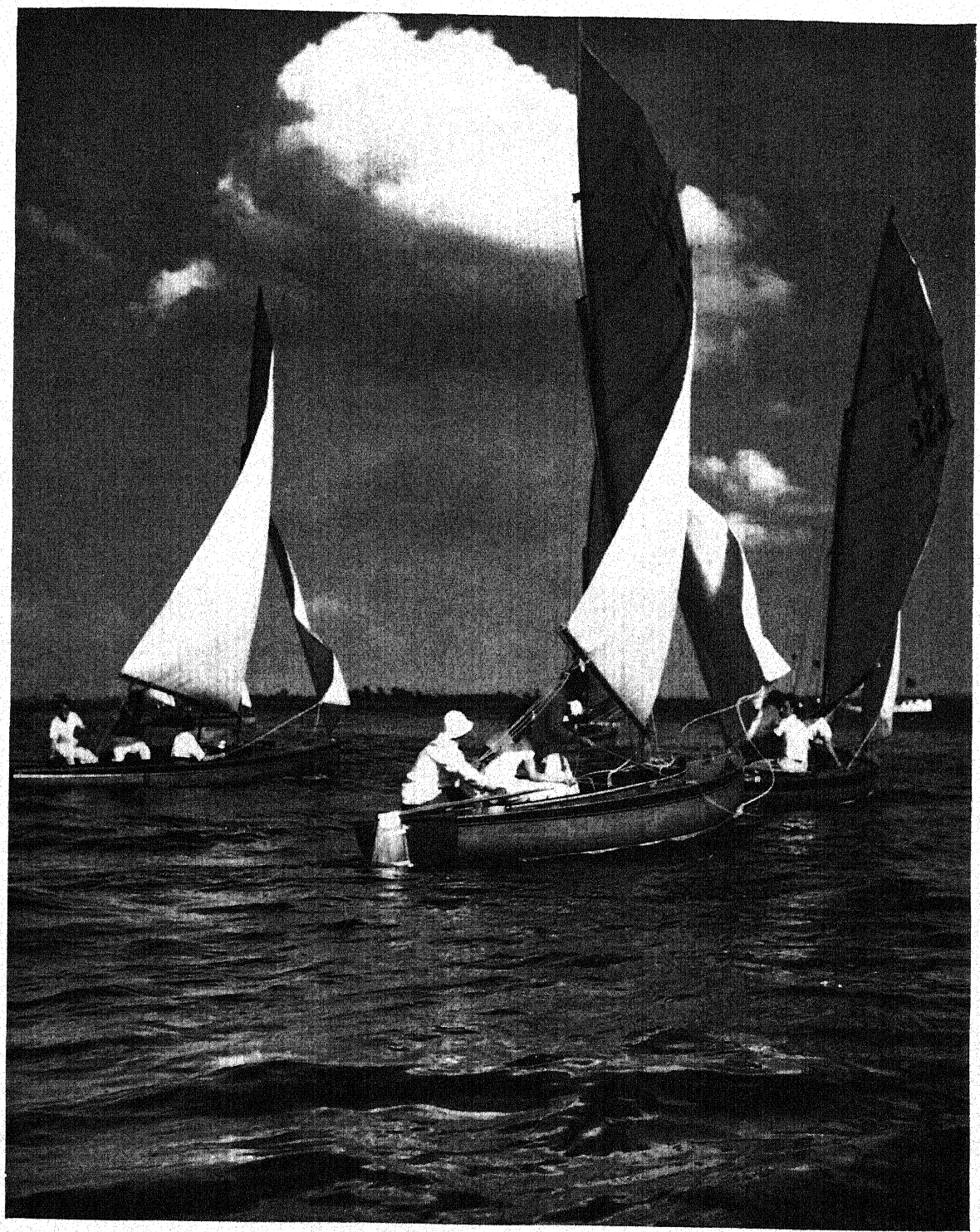
(See *article on Child Photography : Professional, pp.* 281-284)



IN AN OLD YARD

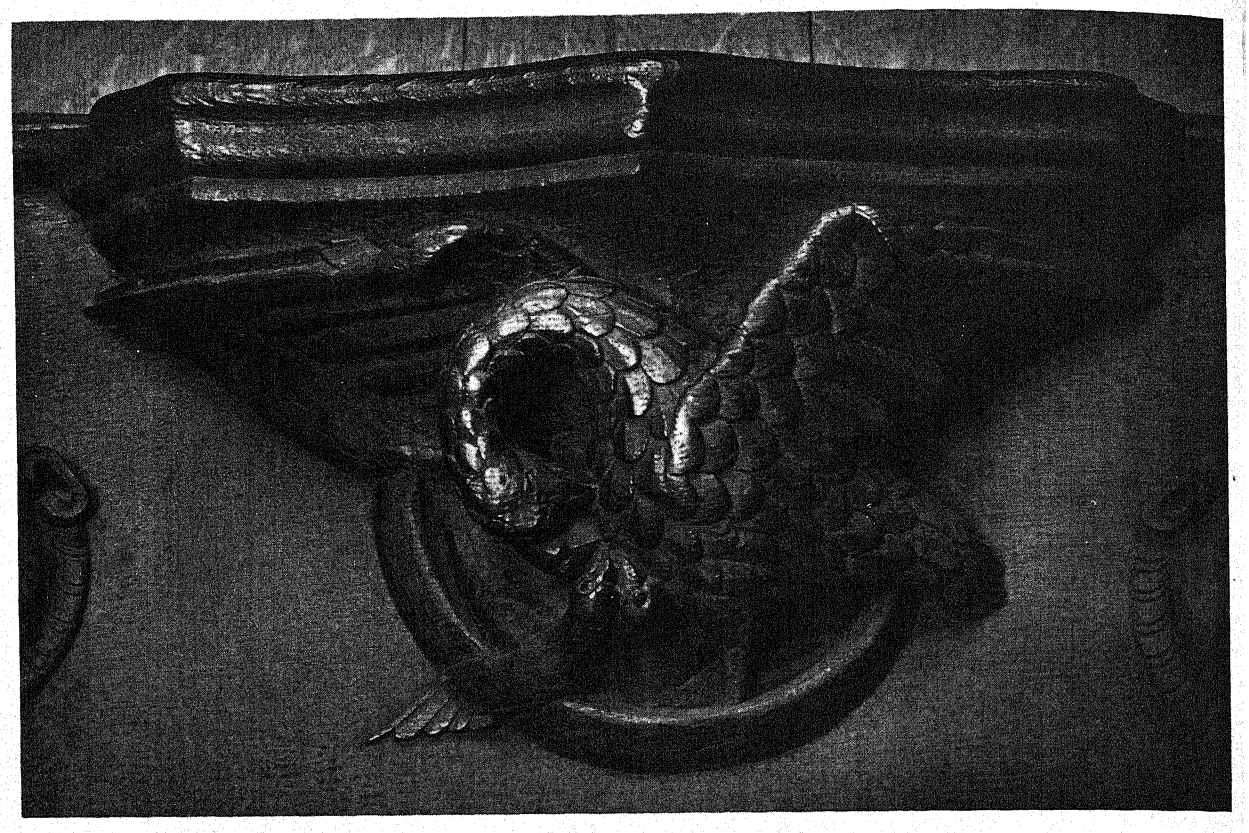
Charles F. Lonsdale

Zeiss Ikon Maximar camera, f5.6, Agfa Isopan film, Tessar lens, 1/25 sec.



START

Rolleicord with Triotar lens, 1/100 sec. at f8, Agfa Isopan film, graduated filter. An example of brilliant water and cloud photography (see article in pp. 347-354)



MISERICORD AT RIPON — Dr. K. I. Johnstone, A.R.P.S.

Quarter-plate Sanderson camera with 4¾-in. Zeiss Tessar lens, exposure 10 mins. at f18, Agfa Isochrom film. Six-volt 9-watt lamp for lighting.
(See article on Church Photography, pp. 293-294)

CENTRAL ARCHAEOLOGICAL LIBRARY New Delhi 392

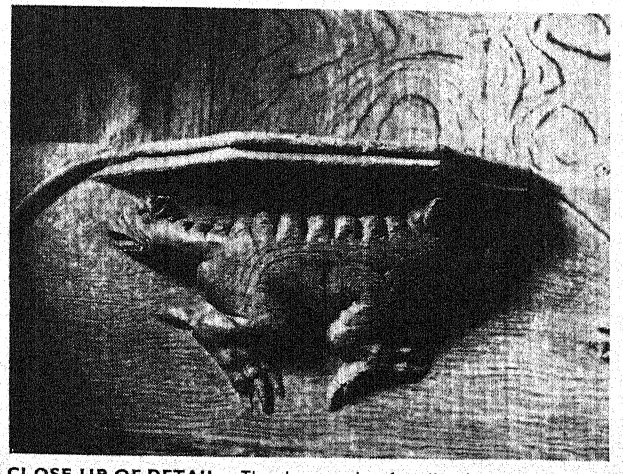
To those not familiar with the subject, a look-out should be given for old pulpits, such as the fine example of carving which was taken in Stoke D'Abernon Church. Old fonts and font covers make interesting subjects; the one illustrated is a Saxon font in the old tower (probably Norman) of Thames Ditton Church. An example of fine old roofing in Chessington Church is also shown; the last opening in the wall on the left-hand side is a "leper hole," through which the sufferers followed the service from outside.

Old brasses, clocks and relics of tombs form an endless variety of subjects for the photographer. It was the custom long ago to place some personal relics on the tombs of worthies buried in the church, such as pieces of armour, valuable old flags, and in some cases these have been preserved.

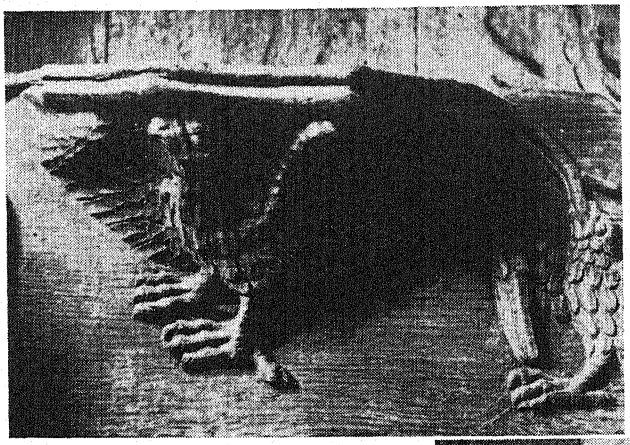


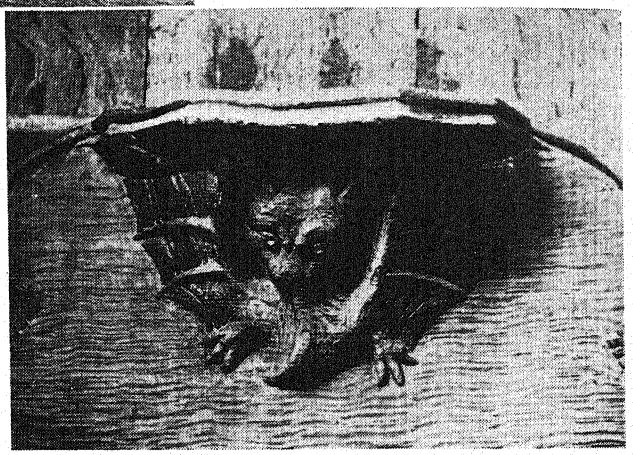
AN ANCIENT NAVE. Here is an excellent example of a general interior view, in Walton-on-Thames Church, with the old organ at the back
3 mins., f11, S.S. pan. film

Most old churches boast a gallery; it is often from here that the village orchestra played before the advent of the organ, and some of the first organs can still be seen—wheezy old hand-pumped affairs that will give the photographer and historian more pleasure than the clergyman, and should be photographed before the latter has managed to raise sufficient funds to get a replacement. One may be only just in time to record some interesting feature before it has faded into the forgotten, in the glory of modern replacement or renovation. These subjects should therefore be photographed without delay before they are all gone, or before "modernization" has rendered them unrecognizable. The tone or colour of the surrounding decorations may also be altered, taking away some of the mellow beauty of the old work. Incidentally, it should be noted that a tripod to carry the camera will be a necessity for this work.—*B. ALFIERI.*



CLOSE-UP OF DETAIL. The photography of small architectural details is perhaps more interesting than that of large interiors. This misericord (seat) is in Edlesborough Church, Bucks.
Photo, I. D. Robinson: 16 secs., f5.8, Panatomic film





MORE CHURCH DETAILS. These fantastically carved misericords were found (above) in Wysall Church, Notts.; and (below) Edlesborough Church, Bucks. Both are beautiful examples of craftsmanship and photography

Photos, J. D. Robinson; above: 30 secs., f8, Verichrome. Right: 10 secs., f5.8, Panatomic film

Carvings. Carved woodwork abounds in old churches. Stalls, with allegorical carvings, with their coats-of-arms and finials, their misericords under the seats are rarely photographed. Fine stonework also abounds on tombs, on the walls, inside and out; by old doors. Stone was also used as a medium for telling all kinds of stories, and many are the amusing carvings which can be found, if they are looked for.

In the photography of bench-ends on stalls, the first thing is—use differential focussing. There is nothing more ruinous to a photograph of a bench-end than a glaringly sharp background. The background should be thrown as far as possible out of focus in order that the bench-end shall stand out in relief. They are usually well lighted, and an exposure of five minutes at *f*8 with a fast plate or film is usually quite sufficient.

The photography of misericords, however, is a very different matter. These carvings are low down near the floor and under a seat; in front of them, at a distance of about two to two and a half feet, is a pew which effectively blocks out the light. They are often so badly lighted that it is impossible even to see that there is a carving there at all without using an electric torch.

These misericords are quite the most interesting of all ecclesiastical carvings on account of the wide diversity and the interest of the subjects they represent. In order to photograph them one has to get one's camera on a tripod at a height of about a foot from the floor between the carving and the pew.

The exposure for misericords is a very variable quantity because of the great variation in the density of the light in different churches. If only the daylight that reaches them is relied on, the exposure may be from one to two hours at *f*16, as it is necessary to stop down considerably to get all parts of the carving in focus. The alternative is to use artificial light, which may be supplied by one or two electric torches or by using a Sashalite or similar flash-bulb, as obviously ordinary flashlight is out of the question in the circumstances. By using the electric torches and the fastest panchromatic plates of film, the exposure can be reduced to a few minutes.

Stonework is usually easy to deal with; the only difficulty is the colour of stone, which tends to give very flat negatives unless the subject is appropriately lighted to emphasize relief.

Two things to avoid are over-exposure and under-development. Development should be carried farther than usual in order to produce a maximum amount of contrast. An exposure of more than five minutes is very rarely needed for interior stonework details.

using *f*8. This can be considerably reduced if auxiliary artificial light is used.

So far as equipment is concerned, a focussing camera and tripod are desirable, although a certain amount of detail can be attempted with practically any camera and a tripod.

If, however, the amateur wishes to undertake the photography of this subject seriously, he will find it useful to have a camera with double extension and focussing screen, as well as several alternative lenses—notably a telephoto for details that are out of reach, and a wide-angle lens for very confined situations. A reliable exposure meter will also prove useful.—*R. S. ILLINGWORTH.*

PHOTOGRAPHING MONUMENTAL BRASSES

This little-known branch of ecclesiastical photography is yet of great interest to the lover of antiquities, and good photographs of brasses have a high rarity value. The simplest method for obtaining them is described in this article by D. D. Constable

Ancient memorial brasses offer a subject of entrancing interest to the amateur photographer.

There are in England about four thousand of these artistic monuments, and they illustrate the whole history of armour from its introduction to its decay, and the costume of men and women through 500 years.

Unfortunately, as the majority of brasses are either fixed to the floor of the church or else lie on flat slabs at the top of altar tombs, to photograph them as they are will be found to be exceedingly difficult and in many cases impossible.

Here, however, is a method by which good results may be obtained with very little trouble. Obtain a roll of white paper such as is used for lining shelves, and which is generally sold in rolls of about twelve yards. The only other article needed is a piece of cobbler's wax (sometimes known as "heel-ball").

Stretch the paper across the brass and put down weights to prevent it slipping. Then, if the heel-ball is rubbed over the surface of the paper a perfect black-and-white impression of the brass will be obtained.

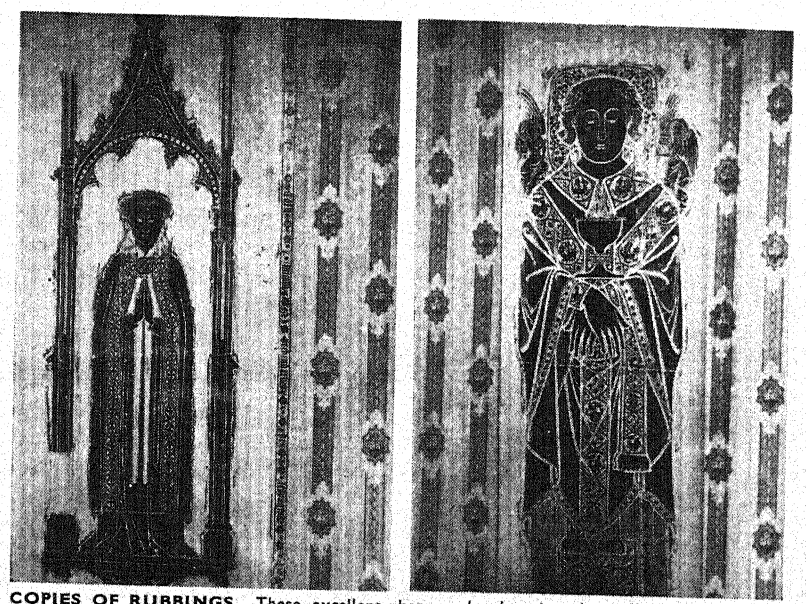
If, as is sometimes the case, the brass happens to be on the wall of the church, gelatine lozenges will be found useful for holding the paper in position. If the brass is fixed to wood, drawing-pins will come in handy.

The rubbing can afterwards be mounted on paper or calico and photographed without any difficulty. The best method is to fix it to the wall of a well-lighted room, against a background of white cloth. Generally an exposure of about two minutes at *f*16 will be sufficient.

If irregular lighting causes trouble, this can often be remedied if a white screen is placed at such an angle that it will reflect light equally over the rubbing.

It will be found that brasses give many fascinating glimpses into the manners and beliefs of their time.

Before a rubbing is taken, permission to do so should, of course, be obtained from the vicar.



COPIES OF RUBBINGS. These excellent photographs of ancient brass "rubbings" are of memorials to John Marshden, Canon of Windsor, 1425, at Thurcaston, Leicestershire (left); and (right) Sir Simon de Wenslaugh, at Wensley, Yorks.
Photos, D. D. Constable; 2 mins., f16

CHURCH PHOTOGRAPHY: PICTURES OF FONTS

Like brasses, fonts provide a specialized field in which good photographs are not common. This article by Donald G. Sheldon gives details of the camera, length of exposure, development, etc., necessary to gain the most satisfactory results

Collecting fonts with the camera is an attractive branch of photography. It can be practised at all seasons and in all weathers as long as there is daylight. The varieties of shape, size, ornament and material are almost endless. Subjects are plentiful; wherever there are churches there are fonts.

Elaborate apparatus is not necessary for this work. Small stops and time exposures will be required; so the cheaper cameras will do just as well as more expensive ones. A tape measure should be carried so that the camera may be focussed by means of the distance scale. Even if the camera has a focussing screen it is not always possible to use it when working in very restricted spaces.

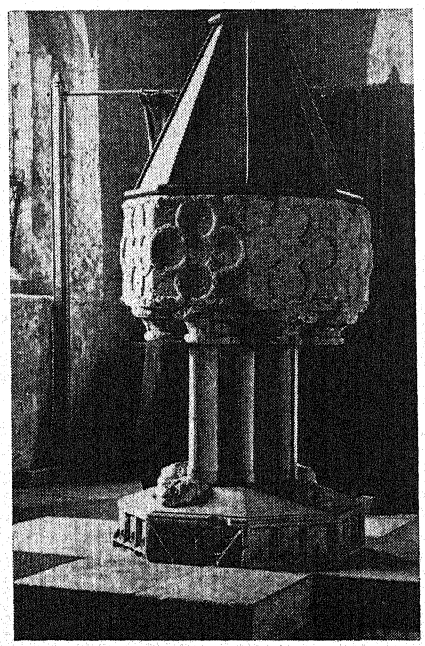
A tripod is essential, as it is usually impossible to find any other suitable support for the camera in the desired position. A pocket flashlamp is useful for inspecting camera scales and settings in dark corners, and for lightening areas of too deep shadow in the subject. When focussing by screen in a badly-lit church, the lighted flashlamp laid on the front edge of the font and then at its base gives two useful points to focus upon, both for sharpness and to ensure the whole of the subject being included.

Exposures vary greatly according to the tone of the font and the light available. It should be generous, for church light is often poor and of low actinic value. Full advantage should be taken of modern high-speed plates or films, which will shorten exposure considerably; these should be backed to avoid halation. Those who have not attempted this work before might give as a trial ten minutes at *f*16 about midday, increasing the time if much earlier or later, or in the winter months.

Development of the negatives should be of a shorter time than usual, as interior subjects tend to be contrasty, and full development would give very harsh results.

The finding of the best viewpoint may need some care, since it is desirable to combine the best aspect of the font with the most pleasing lighting and the least distracting background. Often it is impossible to avoid the inclusion of incongruous features, such as radiators or hymn-book shelves; in such cases one may have to rely upon differential focussing to lessen their distracting influence. When possible, windows should be excluded, as they form bright high-lights which detract attention from the font.

The usual position for the font is at the west end of the church, near the south doorway or the main entrance. Its size may vary from a huge, tub-like vessel to a small, shallow basin; its material may be limestone, granite, gritstone, or marble. The ancient fonts are usually large, since in olden times infants were baptized by immersion.



FINE OLD FONT. This well-lighted photograph is of the font at All Saints, Saltfleetby, Lincs.
Photo, D. G. Sheldon: Zeiss Ikon Ideal, 10 mins., f16

Though there are many plain square, circular, and six or eight-sided fonts dating from Norman times onwards, the design of old fonts often reflects the style of architecture at the time it was made. The early craftsmen often lavished their best work upon the font, so that many specimens are richly decorated with the mouldings and ornament characteristic of the period.

Many old fonts have covers which are worth including, as they are sometimes splendid examples of the woodcarver's art. Some of them are very heavy and hang from a chain, by which they can be raised when desired.

CINEMATOGRAPHY (STANDARD): GENERAL SURVEY

The Art and Practice of Motion Picture Production

James Mitchell, B.Sc., A.I.C.
Of Ilford, Ltd.

This, the first article in our series on Cinematography, introduces the subject with an historical and general survey of the production of 35-mm. films from Louis Lumière's "exhibitions" at the Polytechnic, Regent Street, to the latest Hollywood talkie "epic," and explains simply "how it is done." Following we have five articles which deal in detail with the practical and creative aspects of the sub-standard cinematograph for both beginner and advanced amateur

A LENGTH of photographic film is made to pass through a camera in steps. The camera shutter is synchronized with the intermittent motion so that the film receives an exposure each time it comes to rest and the shutter is closed while the film is in motion. Successive portions or "frames" of the film thus receive exposures following closely upon one another in time. The negative record is developed, a positive print is made and projected upon a screen by an optical lantern embodying intermittent motion, similar in principle to that of the camera but differing from it in design, and the result is a moving picture.

A microphone diaphragm vibrates in sympathy with the human voice, the vibrations are translated into electrical pulses, these pulses are made to affect a beam of light and the result is recorded on photographic film. This record is printed on to the picture positive along one edge of the picture, and as the film passes through the projector and while the image is moving upon the screen the sound track is being "decoded." The projector has a "sound gate" in addition to the "picture gate," and as the track passes the former it causes fluctuations in a beam of light falling upon a photo-electric cell. The fluctuations are translated back through electrical pulses into sound waves, which reach the audience from loudspeakers situated behind the screen. The moving picture has now become vocal.

History of the Film Industry

On this cycle of operations has been founded the great motion picture industry, the importance of which may be judged by reference to the following figures.

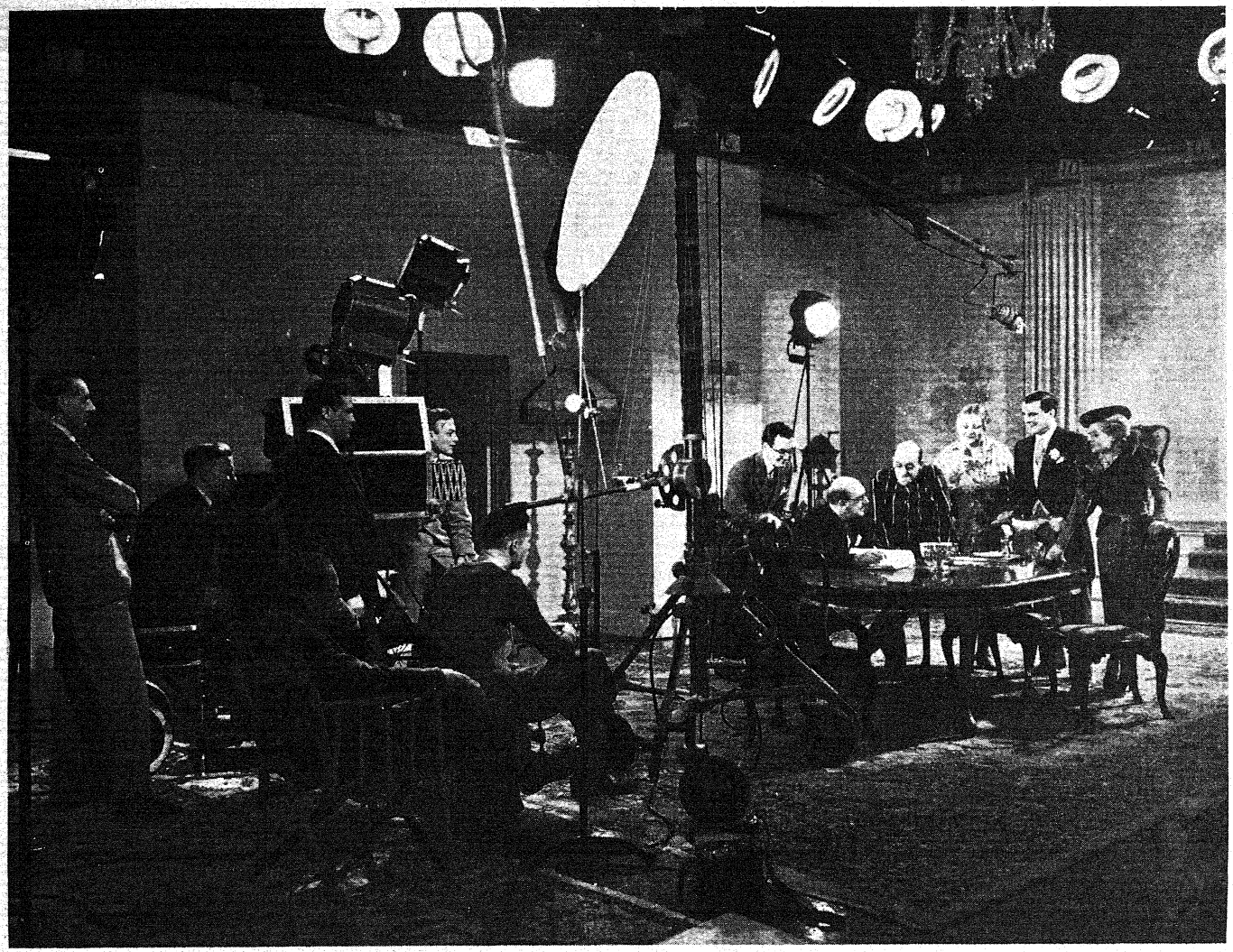
In America the industry, localized almost entirely in Hollywood, occupies some 28,000 people, and it is estimated that a further 236,500 persons are employed in the 15,378 theatres in that country. In 1936, 500 feature films were made in America together with 1,000 short subjects, this total constituting some 70 per cent. of the world's supply of motion pictures and representing a production expenditure of something like 135,000,000 dollars. There are between 4,000 and 5,000 cinemas in Great Britain, the average seating capacity being in the neighbourhood of 900, and in 1934 the number of admittances to these cinemas totalled 957,000,000. To meet the requirements of British cinema patrons 300,000,000 feet of positive film is manufactured, printed and processed every year. The negative stock involved also assumes colossal proportions.

England's First Commercial Cinema

Yet it was only in 1896 that Louis Lumière gave the first public exhibition of his Cinematograph to a paying audience in Great Britain—at the Polytechnic in Regent Street. On the same day, February 20th, R. W. Paul was demonstrating his Theatograph at the Finsbury Technical College.

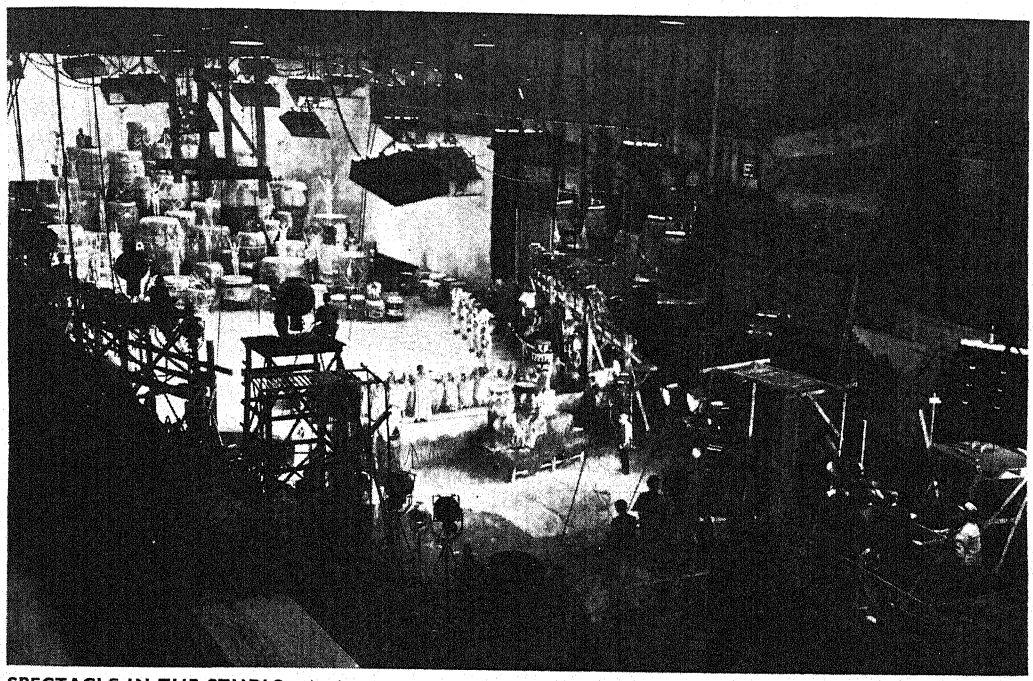
Progress in America was rapid, and from the beginning the American film was more closely allied to the national life than has ever been the case in Great Britain. In the opinion of many this explains its enormous vitality. By 1907 the ten producing companies then operating in England were faced by such serious competition that the Kinematograph Manufacturers' Association was formed to regularize the industry. An International Conference was called in 1909, but before anything could be done the exhibitors made an agreement with the Americans to take a certain number of copies of everything produced for a number of years to come. Thus began the American domination of the industry.

Up to 1927 America completely monopolized the British market, and the Quota Act of 1927 was designed to remedy this



ON THE SET. A scene in the studio during the making of a British comedy. Such a scene, though the result of months of preparation and the co-operation of many technicians in every kind of craft, may last less than half a minute; yet it has to be as carefully lighted, recorded and photographed as any epic

Courtesy of Associated British Picture Corporation, Ltd.



SPECTACLE IN THE STUDIO. In this "still" taken during the making of the film, "Radio Parade of 1935," one of those breath-takingly spectacular scenes so popular in "musicals" is seen being "shot." Enormous batteries of powerful lamps have to be used to light such a vast area as this

Photo by courtesy of the Associated British Picture Corporation, Ltd.

state of affairs. In the early days copies of films were sold outright to exhibitors, but this system was replaced by the present scheme whereby films are acquired by renting companies who lease prints to exhibitors for definite periods. Under the Act referred to renters are compelled to acquire and to distribute a certain proportion of British pictures, and in similar fashion exhibitors are compelled to show a certain proportion of British pictures on their screens. Unfortunately, as a direct result of this act there emerged the "quota quickie," the "British" film made at the lowest possible cost and in the shortest possible time to satisfy the law's requirements—the type of film which has done most to injure the prestige of British films. New legislation was in contemplation in 1937 to remedy this state of affairs. Meanwhile, a part of the industry in Great Britain is threatened with financial disaster due to ill-advised attempts to capture world markets with films produced almost regardless of expense.

The colossal progress made would never have been possible without the co-operation of technicians in every branch of the industry and in the associated industries. Manufacturers of celluloid, of photographic emulsions, of camera equipment, machinery for film manufacture, for projection, etc., all have contributed. The technicians within the industry have had to develop a technique for a medium which was itself continually changing. In the days of the silent films, players had to rely on pantomime and on the mute eloquence of gesture assisted by the good offices of the caption writer.

Then came the "talkie" and the old technique was dead even before it had attained to that dignity. Cinema patrons scarcely realize the extent of the change. Previously they were dependent for "incidental" music on the efforts of a pianist or of an orchestra, according to circumstances. Now the music the public hears, like the voices of the "stars," is brought to them on the film itself. To secure an adequate length of sound track it was found necessary to take and project film at the rate of 24 pictures per second instead of 16 as formerly, although had it been possible to take film running horizontally in the camera instead of

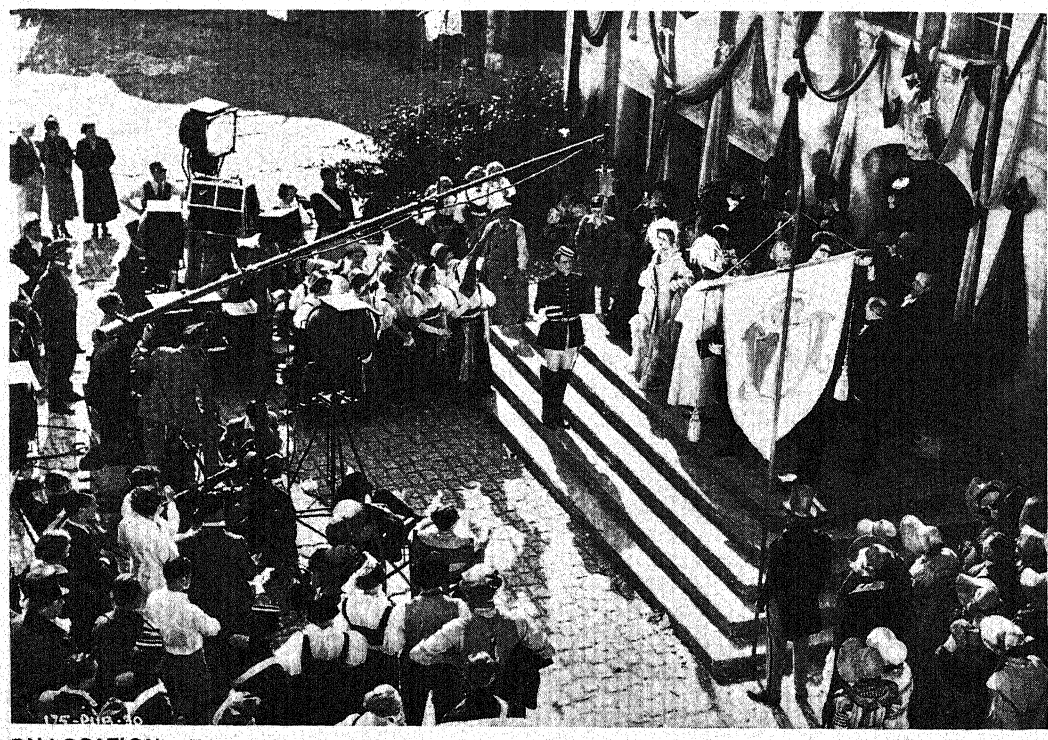
vertically, no increase would have been necessary as the sound track would have been along the long side of the picture. The sound track uses up a little of what used to be picture area, and so to preserve the 4 : 3 length to depth of picture ratio the picture had to be curtailed a little top and bottom.

Colour on the Films

Colour cinematography presents many problems, not all connected with the particular process used, and involves still more drastic alterations in production technique. Whilst providing the director with new opportunities for effect, it undoubtedly imposes restrictions in other directions. Colour on the screen ought to make for greater realism, but it is questionable as to whether or not it does so and also as to whether greater realism is exactly what is required. In the first place pictures are two-dimensional representations of three-dimensional scenes and as such cannot be completely realistic. An artist painting in colours never tries to reproduce the exact tints and hues which his eye sees. He paints them as he has learned they must be painted if they are to convey the expression of rightness to the observer. The camera cannot interpret in this fashion, and any modifications which are necessary must be made in the subject itself before the photograph is taken.

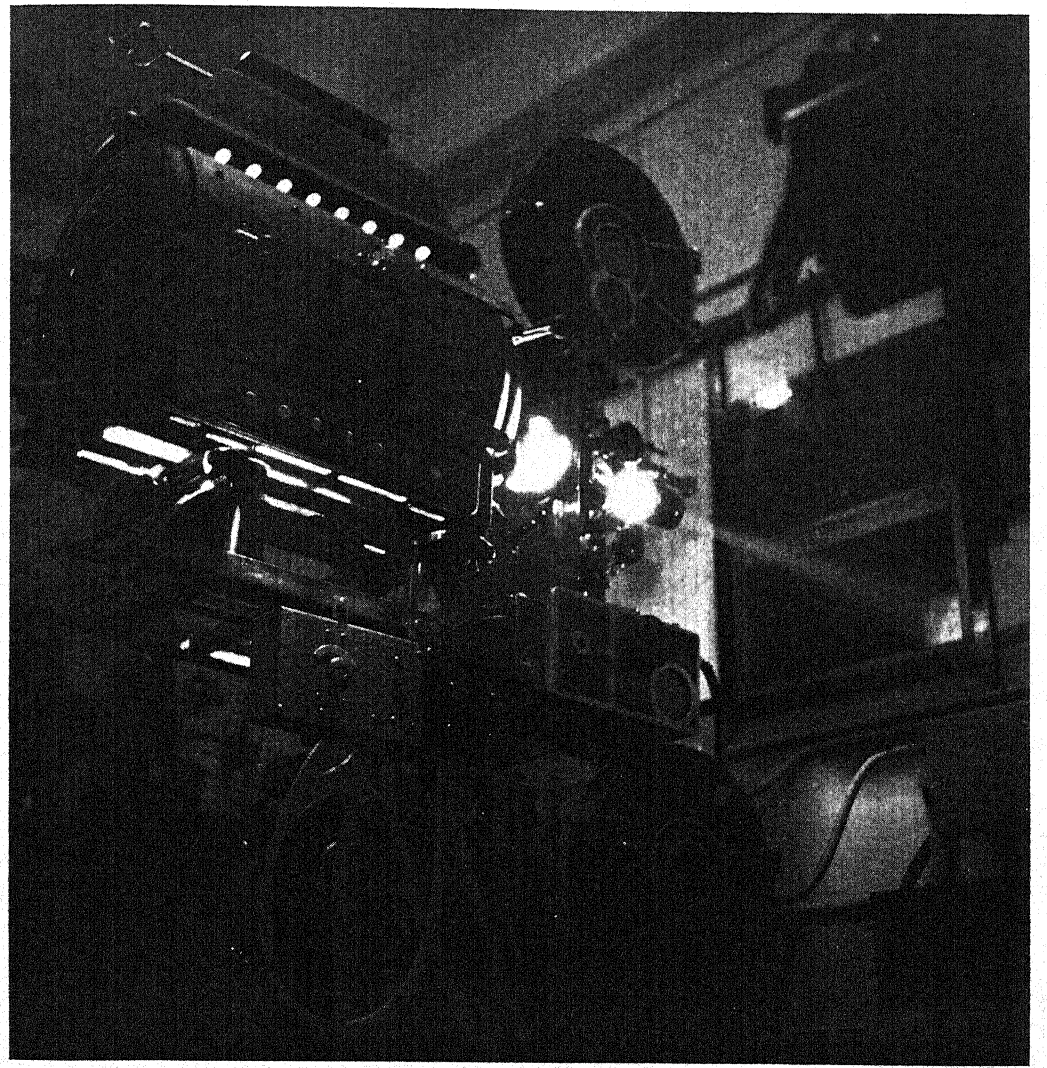
There is some ground for the view that a colour photograph of an artist's representation of a particular scene may be much more satisfactory than a colour photograph of the scene itself. In this way unwanted and meaningless detail can be omitted without definition becoming impaired, while important matter is emphasized.

A further point is that the eye, looking at a three-dimensional subject, sees only that part of it to which it is attending—the rest of the subject is but vaguely apprehended as being present. The edges of the field do not obtrude. On the screen, however, the eye sees everything and subsidiary coloured objects at the edges of the picture tend to steal the stage. In monochromatic photography soft focus can be used to offset this effect, but with colour this



ON LOCATION Here is an action "still" from the film "Student's Romance." The position of the microphone in front of the main character, and just sufficiently high to be out of the picture, should be noted

Courtesy of Associated British Picture Corporation, Ltd.



IN THE PROJECTION ROOM. A cinematographic projector such as is used in the commercial cinema is here seen in action ; the beam of light is passing through the oblong aperture at the back of the theatre, with which all cinema-goers are familiar. The lamp-house, film chamber and lens system are clearly shown. The photograph is an excellent example of "still" technique *Photo, Ilford, Ltd.*

technique cannot be used because out-of-focus colour is more obtrusive still.

Finally, it may well be that some attention should be paid to the change which occurs in the sensitivity curve of the human eye when the latter has become accustomed to the dark. Up till now the attempt has been made to secure a projection print having the colour balance of the original subject, but it does not follow that this procedure will necessarily result in the production of a screen image that will appear satisfactory to eyes which have become accommodated to the semi-darkness of the cinema interior.

A graver difficulty which faces the maker of colour films is the great differences in colour quality which exist among projector arc lights. A print which may be in perfect colour balance when seen by low intensity projection may be unnaturally cold when projected under high intensity arc. Much may be said on paper, but while controversy rages better and better colour films are being made. The technicians on the studio floor are more alive to the difficulties which beset them than are their critics, and the colour film has progressed enormously in the last few years. Each successive film produced

by Technicolor provides undeniable evidence of the advances made, and processes in general are becoming more manageable. In 1935 a Dufaycolor film was made of the Jubilee procession and of many of the other notable events of that year. In 1937 the Technicolor and Dufaycolor films of the Coronation procession created a minor sensation. The improvement in quality was marked. The news reel has always led in the triumphal march of the cinematograph industry, and as the medium by which colour can be introduced to the screen the news reel has many advantages. Here realism counts every time and artistry is less important. But the public has become accustomed to see news reels produced at speed, and colour processes are not at their best when results must be rushed to the screen. Time is required even with the simplest to balance for colour and to maintain quality.

The one branch of film work in which colour has already triumphed over black and white is the Cartoon, and here Disney holds the field. In this particular instance the position is simplified—the artist is in complete control of the situation. He chooses his colours, he outlines his figures in black to bring them out from the background. He uses light washes on the background to keep it in subjection. He is not trying to produce a realistic result and, above all, he is making only a two dimensional picture.

The Making of a Film

Film scenarios are either written specially for the purpose or successful novels are modified in such a way that they become suitable for cinematic treatment. From the scenario a shooting script is prepared complete in every detail and covering every camera shot which will have to be made. In general, specialists are referred to for technical details and the highest authorities are consulted to ensure that the " atmosphere " shall be correct. Every effort is made to ensure that period " properties " shall be accurately reproduced. This involves a good deal of work by the staff of the property department, who do the most amazing things with plywood and plaster. The great rule is to build no more than is actually necessary—what the camera will not see can be neglected.

The treatment of the film is in the hands of the director, whose function it is to interpret the story in terms of the cinema, and he must see that the lighting and camera work are giving him the desired results. Lighting is the duty of the first cameraman, who must work in close touch with the director. Each scene is rehearsed until the action is satisfactory before the camera is turned.

' Shooting ' and ' Continuity '

A film is never shot in story sequence. All shots concerned with a particular set are photographed one after another, and in general all interior scenes are made before exteriors or vice versa. The economy of this is obvious, as it enables sets to be scrapped immediately after use with a minimum waste of floor space, time and labour. But it entails a considerable amount of work for " continuity," whose duty it is to see that no action is omitted and that details of dress and of properties do not vary from scene to scene without reason.

The foregoing details apply more particularly to interior shooting, but the modifications in technique for exterior work will be obvious.

The camera equipment of the modern studio must be silent in operation, and much work is being done in an effort to produce silent running machines which shall be light and reasonably portable. Mitchell, Bell-Howell, Vinten, Debrie, and Eclair are among the leading makers. The Newman and Sinclair Auto-Kine camera is very popular wherever portability is an asset.

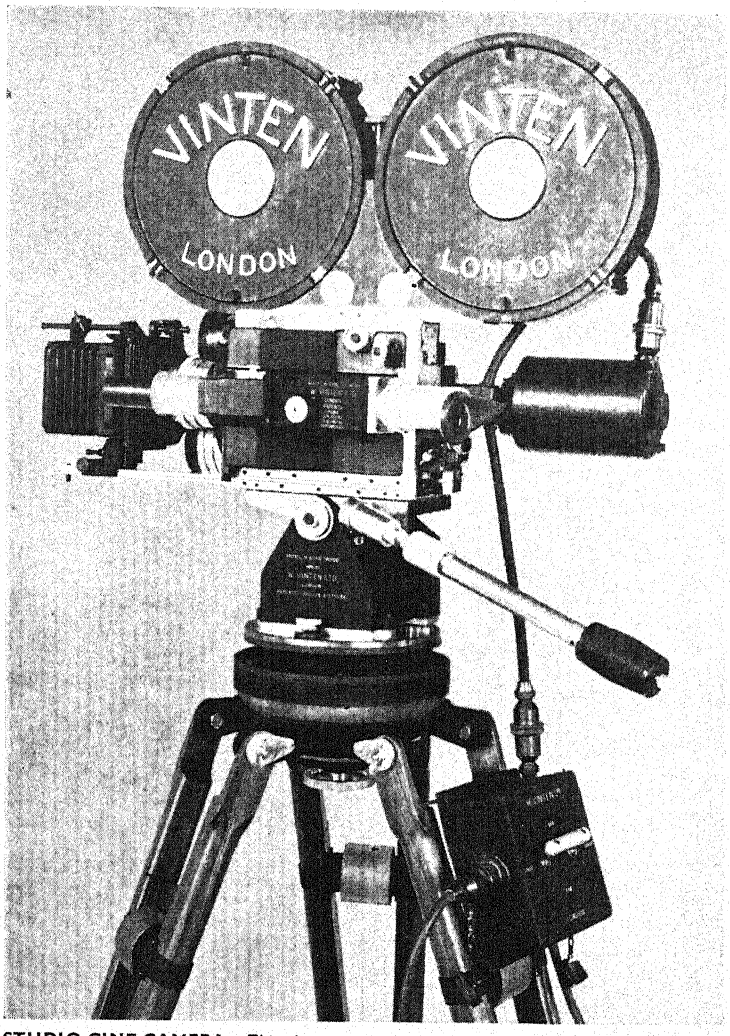
The intermittent motion in cameras is usually achieved by a mechanism of the claw type, greater steadiness being obtained with this than with a Maltese cross movement, such as is adopted in projectors. There is no necessity for a very fast " shift " movement for camera mechanisms, as there is in the case of projectors. Many cameras now employ dowell pins to secure accurate registration.

Camera work nowadays is an affair of angles, and the equipment includes cranes and cradles from which special shots are made. Tracking shots are made with the camera running on rails for steadiness.

Panchromatic negative is the stock universally used in the studio and for exterior

work. It not only enables the utmost use to be made of artificial light courses which are deficient in blue, but it allows for reasonably good monochromatic rendering of coloured objects even without the use of filters. The cameraman rarely worries much about accurate colour rendering as such. He uses filters mainly on exterior work for haze penetration, to give cloud rendering, and to produce night effects during the day. For the latter purpose it is best to use infra-red negative with an infra-red filter. Care must be taken to underexpose slightly and to ensure that there are no white clouds in the portion of sky photographed.

The lighting used in motion pictures is either tungsten filament or arc, the latter coming once more into favour after having suffered a relapse from popularity when sound came in because of arc hiss. Arc lighting, with its high blue content (white flame carbons give a very close approximation of daylight illumination), is almost essential for colour work. Colour at present requires a great deal more light than is necessary for black and white photography, and if incandescent lighting is used the amount necessary is so great that inconvenience results from the heat generated.



STUDIO CINE CAMERA. This photograph is of the Vinten Model "H" Studio Camera mounted on a gyroscopic tripod and complete with an A.C. synchronous motor and switchbox, and a magazine to hold one thousand feet of 35-mm. film

Power For Pictures

Arc lamps of the Mole-Richardson type are becoming increasingly popular.

The current supply required by the large production companies reaches colossal proportions. At London Films, for instance, the power station is equipped with six diesel electric generators, each giving 750 k.w. The stages themselves are wired so that on each stage 15,000 amps. at 110 volts are available. For special purposes 45,000 amps. can be obtained—nearly 5,000 k.w.

The lighting technique employed depends upon the subject, the treatment and the cameraman. In general, frontal light is used for general illumination, side lighting for strength and top light on the hair to outline and "pick out" from the background. Except in special circumstances, the aim of the lighting expert should be to secure a natural effect. Doubling of shadows in

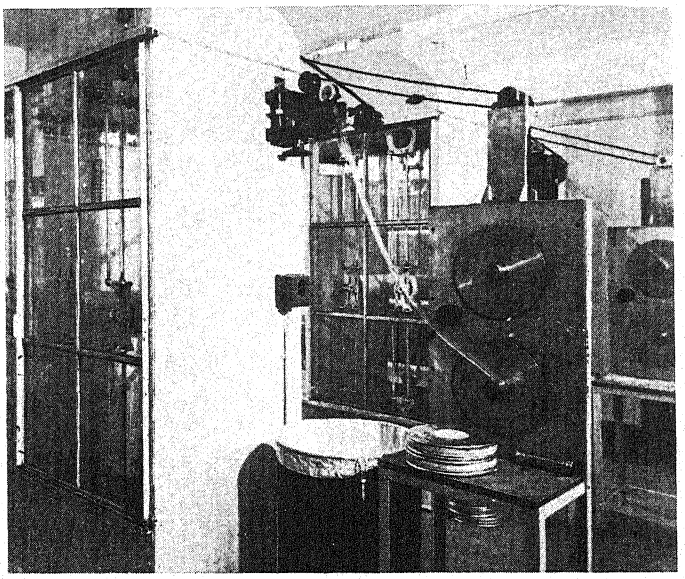
artificially lit sets representing daylight scenes must be avoided.

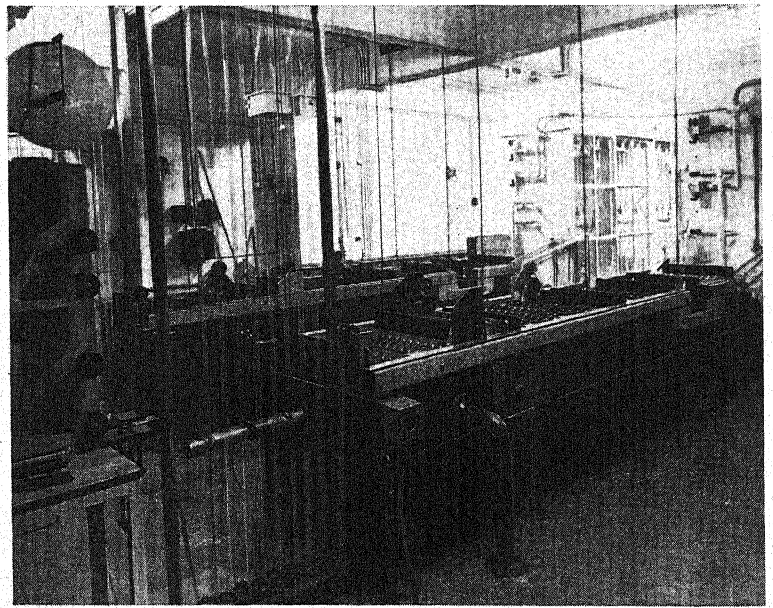
Except occasionally on exterior work, sound is never recorded on the picture negative. This method has too many limitations.

Sound and pictures may be recorded simultaneously on separate film, using the striking of clappers as an easily identifiable synchronization mark at the beginning of each scene. In some cases simultaneous recording is not satisfactory because of the immobility of the microphones and the difficulty of obtaining tonal balance between, say, the various parts of an orchestra. Sometimes several microphones are necessary over different parts of the orchestra. It is actually common practice to have no orchestra on the set during shooting, but to put the complete orchestral accompaniment on the cut and assembled film. The play-back method is in common use. In this case the music is recorded first without picture and the track thus made is reproduced during the shooting of the picture.

In the recording of a particular number the first step would be the recording of the voice alone with only a soft piano accompaniment to give the artist tempo and pitch. This method gives the director perfect freedom for shooting exactly as he wishes; it enables perfect orchestral balance to be obtained; the words are rendered with greater clarity than would be possible with any other method, and any particular balance between voice and accompaniment can be achieved during re-recording. Unnecessary repetitions are thus avoided when alterations are made.

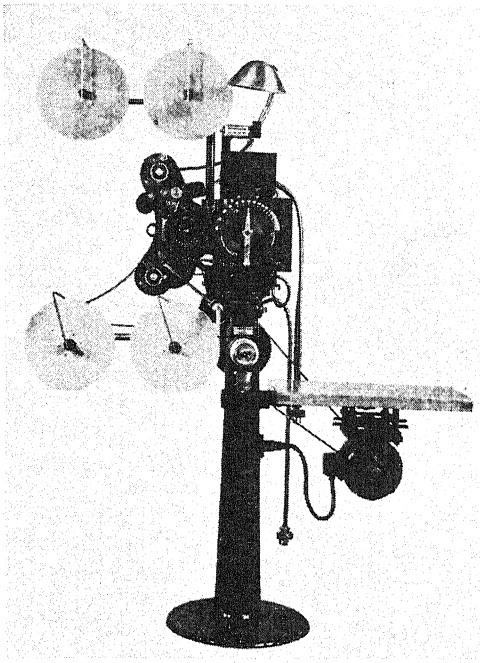
The actual apparatus used in sound recording cannot be described here, but two methods are in use—variable area





HIGH-SPEED DEVELOPMENT. Two views of a modern film processing machine. The temperature of the developing solution is controlled by refrigerating coils and electric immersion heaters, and the solution is in full circulation while the machine is in operation. Some 10,000 feet of film can be completely processed in one hour

Courtesy of George Humphries & Co., Ltd.



PRINTING MARVEL. This machine carries out the positive printing process of cine films at high speed and with wonderful efficiency. It incorporates a semi-automatic light change which compensates for varying exposure in the negative

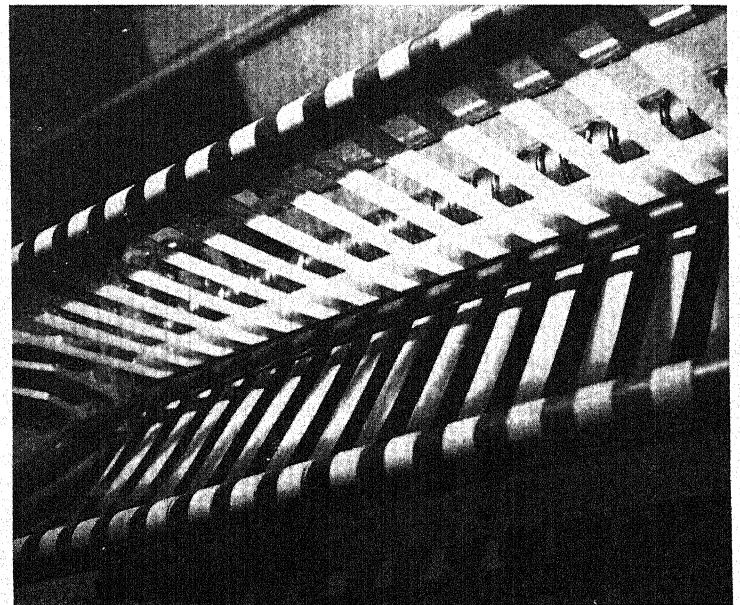
and variable density, each system having its particular advantages. Picture negative is developed generally to a Gamma (*see* Gamma) of 0.65 and sound negative to a Gamma of about 0·35 if variable density (straight line), or 2·0 if variable area—another reason for recording sound and picture separately. Some studios have their own laboratories, but in many cases they send their negatives to one or other of the large processing houses to have them handled.

Here the exposed negative is developed, fixed, washed and dried on continuous machines, which may be of the tank or tube variety, the machines being capable of handling up to 80 feet per minute. Both sound and picture are then printed on to positive stock in synchronization, resulting in the complete "married print." The film is then ready for projection.

It should be noted that for synchronization to be correct the sound must be advanced 19½ frames before the corresponding picture, to allow for the difference in the positions of the sound and picture gates in the projector. Machines for processing positive film are on the market which run at speeds as high as 170 feet per minute.

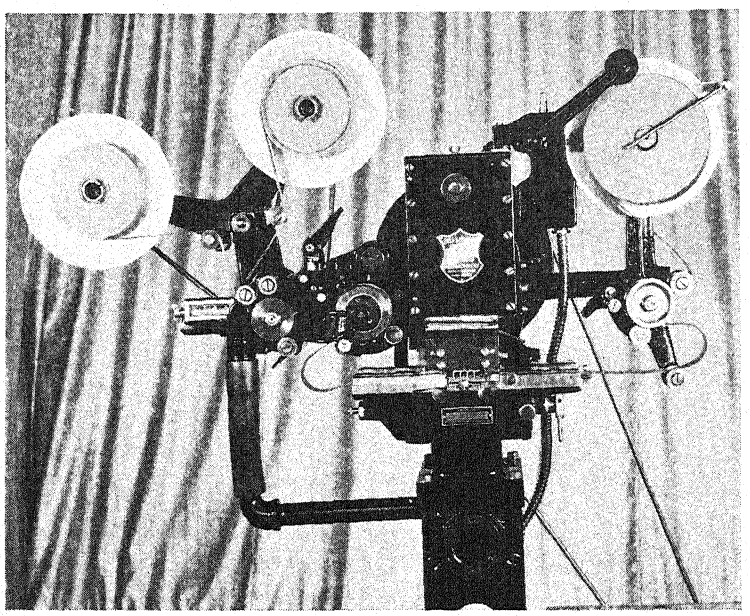
Laboratory control of processing is now maintained by sensitometric methods, and new batches of developer and film stock are checked up by Gamma strips exposed in sensitometers such as, for example, the Eastman Type 2B.

Acetate Base (Non-Flam) The celluloid film made the cinema possible, but the dangers attending its use were early realized. In 1897 73 lives were lost at a cinematograph show in Paris when the film, which was being fed loose from the projector into a basket, caught fire. The extreme ease with which cellulose nitrate is liable to catch fire and burn made necessary the



IN THE MAKING. Production of material for the moving-picture industry is carried out on a gigantic scale. Here is a section of a machine in which lengths of cine film are being cut to the standard 35-mm. width

Photo by courtesy of Ilford, Ltd.



PERFORATING THE FILM. After processing, the film is perforated in the machine shown above. It works to an accuracy of 1/10,000 inch, and can handle 13,600 feet of film per eight-hour day

Photos by courtesy of Bell & Howell Co., Ltd.

Cinematograph Acts of 1909 and 1927, which were designed to ensure the safety of the public. Inflammable films may be shown to public audiences only in premises licensed for the purpose and under prescribed conditions.

The nature of the celluloid base on which cinematograph film is coated made these regulations absolutely necessary, and unless an alternative base had been available cinematography would have been confined to the professional screen. Fortunately cellulose acetate provides a suitable substitute. It has the disadvantages that it is more expensive and more brittle than the nitrate base, but inflammability is very greatly reduced. It will not catch fire spontaneously, nor will it continue to burn unaided; its combustibility is somewhat less than thick paper. The Act of 1909 already referred to specifically exempted non-inflammable films. Although, as stated, "non-flam" film is not strictly non-inflammable, it is sufficiently so to make its general use completely safe.

It has made the art of cinematography a matter of practical politics for the amateur. It has made possible the existence of amateur film societies, and it has made moving pictures available to all schools and colleges for teaching and demonstration purposes. In this connexion the value of the film cannot be over-stated.

Cameras are available today which enable the sub-standard operator to do everything in the way of straight or trick photography which can be done with the standard 35-mm. camera. In addition, sub-standard prints are made by reduction, and excellent film libraries exist from which sub-standard prints of classic films can be hired. Not only is black and white available for the amateur, but colour is also his for the asking, and that by several processes. Sound on sub-standard is also available. For educational purposes, 16-mm. film is excellent. An extensive review of the position in America by the government proved that visual aid equipments "present learning matter so forcibly that education can no longer deny them their proper place in the curriculum." Wider use of sound motion pictures in secondary schools in the U.S.A. is indicated, and similar movements are taking place in Europe.

16-mm. films were used to make records of the 1936 Mount Everest expedition and also on the Nanga-Parbat ascent.

The same ingenuity, the same creative ability, can be exercised in the making of a 16-mm. film as in the production of the full-size film. Cutting and editing present similar problems. Tempo is as important, and a picture can be made by building up atmosphere by judicious cutting.

As regards type of film to be made, the documentary is from many points of view the ideal type for the amateur. The drama is rather outside his sphere, but here again, given acting ability, good direction and a cameraman with a knowledge of lighting technique and make-up, the 16-mm. film need not be a whit inferior to that made on 35-mm.

CINEMATOGRAPHY FOR THE AMATEUR : (1)

Sub-Standard Gauges and Apparatus Compared

Harold B. Abbott

Author of ' The Complete 9.5-mm. Cinematographer '

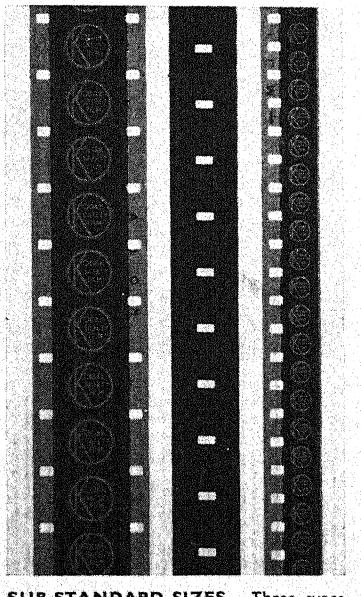
The characteristics and merits of 16-mm., 9.5-mm. and 8-mm. gauges are here discussed impartially so that the beginner can readily determine which will best suit his purpose. Following this is a list of sub-standard cine cameras on the British market, from which specific choice may be made

THE widespread adoption of amateur cinematography may be said to date from about 1923 when the Kodak Company of America and Pathé Frères of France introduced, almost simultaneously, sub-standard gauges of film (*i.e.* film narrower than the "standard" 35-mm. width as used commercially), and also evolved a method of dispensing with the intermediate *negative* film.

Unlike the professional, the average amateur needs only one copy of each film, and (to him) the negative film is, virtually, of no further use once the positive film has been made from it. The introduction of the "reversal" process, by the two companies mentioned, permitted the use of a single film which, after exposure in the camera, was processed in a special manner and became a positive, suitable for use in the projector.

The width of film adopted by the Kodak Company was 16-mm., while Pathé Frères established the 9.5-mm. gauge. Some years later the Kodak Company introduced their 8-mm. film, and these three gauges have remained as the sub-standard sizes of today.

It may be said at once that, so far as results are concerned, every sub-standard gauge of film is capable of yielding (within certain limits of screen size) pictures of a quality equal to anything seen on the professional screen. The great majority of sub-standard apparatus is very efficient, and therefore it may be said that, in the main, the attainment of perfect pictures depends upon the operators, irrespective of the gauge of film.



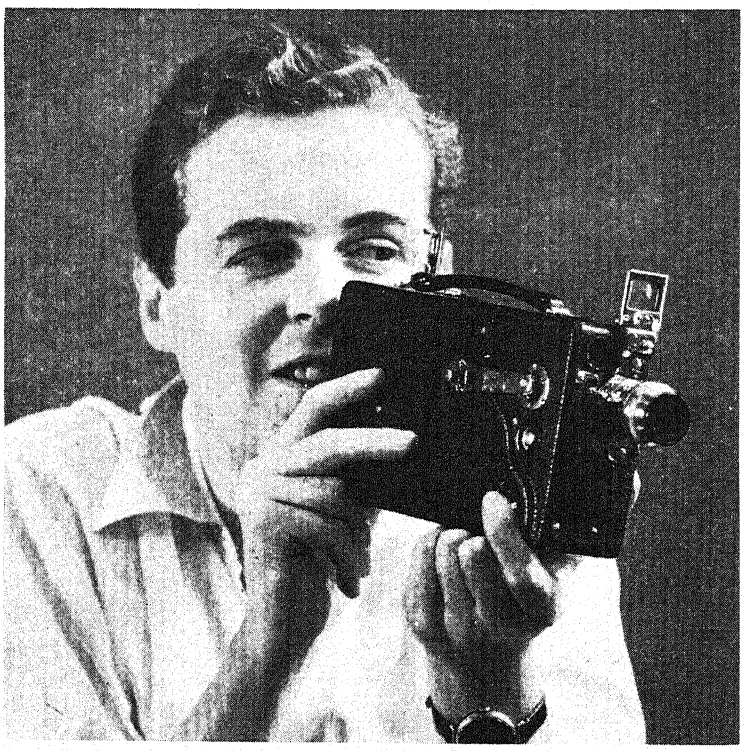
SUB-STANDARD SIZES Three types of sub-standard film shown in actual size. Left, 16-mm.; centre, 9.5-mm.; right, 8-mm.

Choice of Gauge. The two main factors which will guide the amateur in his choice of gauge are : (*a*) purpose for which required, and (*b*) cost. In considering cost it must be borne in mind that, whatever the intending purchaser may be prepared to spend on the apparatus (camera, projector, etc.), it is the cost of film which will continue to affect him after the capital expenditure has been met.

16-mm. Gauge. Where cost is a secondary consideration the choice will probably be in favour of the 16-mm. gauge because, if the advantage of small bulk offered by 8-mm. is excepted, the 16-mm. size possesses all the advantages of the other two sizes in addition to several of its own, its only disadvantage being that it is the most expensive of sub-standard gauges.

The 16-mm. is generally recognized as "semi-professional," and is used more than any other sub-standard gauge for "serious" work, such as research, education, propaganda, and so forth : it is also widely used for entertainment, for personal films, and (by societies) for the production of amateur film plays. A most exhaustive range of apparatus and accessories is available, placing 16-mm. on a footing almost comparable with standard 35-mm. cinematography.

Film is perforated along each edge so that the mechanism of camera and projector may engage and propel the film, there being one pair of perforations to every



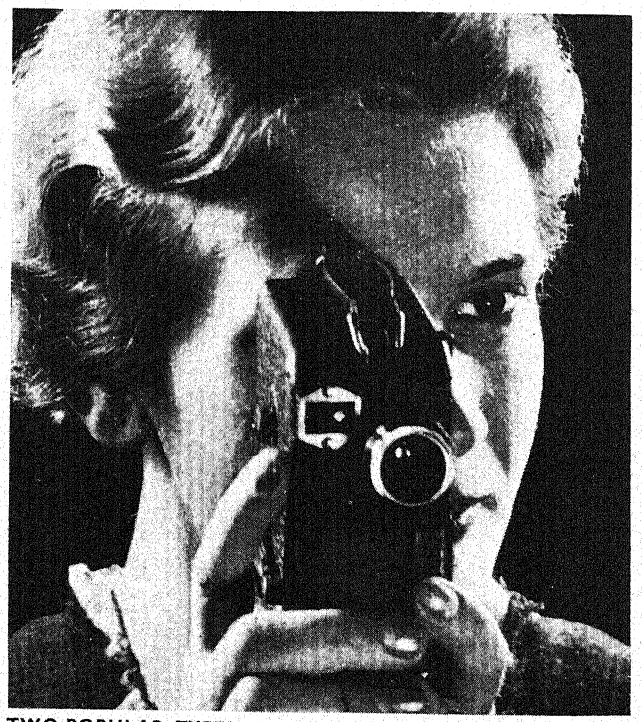
Owing to the unique method of perforating the film—one central perforation on every frame line (*see* Frame, Cine)—the actual picture width of 9.5-mm. film is but slightly less than that of 16-mm., while the number of frames per foot is approximately the same. The practical result of this is that, given a sufficiently powerful projector, the limit of projected picture size is very little less than that of 16-mm.

Many beautiful films, comparable in all respects with anything achieved on 16-mm., have been made on 9.5-mm. stock, but it

frame (*q.v.*), of which there are 40 to the foot. As the normal rate of film travel is 16 frames per second, it follows that 100 feet of 16-mm. film will provide a motion picture lasting for four minutes. Films for use in the camera are normally supplied on spools accommodating either 50 feet or 100 feet; but for certain cameras the film is supplied in a charger which may be removed at any time from the camera without fogging the film (*see* Charger).

In addition to the ordinary black-and-white films, there are at least three different systems of colour film available in 16-mm. size: Kodachrome, Dufaycolor, and Agfacolor.

9.5-mm. Gauge. So far as cost of upkeep is concerned the 9.5-mm. gauge stands at about 60 per cent. of the 16-mm., but the range of efficient apparatus is, in a general way, lower in cost than either 16-mm. or 8-mm.



TWO POPULAR TYPES. The camera shown in the upper photograph is the Cine Kodak model K, which takes 16-mm. film. It is fitted with both a reflecting brilliant view-finder and a direct-vision finder. The spring-driven motor provides two speeds. The lower photograph shows the Pathéscope Motocamera H, a 9.5-mm. instrument. Specification includes an *f*3.5 anastigmar lens, built-in view-finder and film counter

must be admitted that the reputation of "9.5-mm." suffered at first from inefficient processing. Improvements have been effected, and the best-known 9.5-mm. films are now subjected to automatic "compensated" processing, similar to that adopted for 16- and 8-mm. films; but the fact that it is possible to process 9.5-mm. films with comparatively simple apparatus has encouraged some small concerns—not too well qualified—to undertake this work, with results that can only be damaging to an excellent medium.

Apart from low capital expenditure and reasonable cost of upkeep, the 9.5-mm. gauge has certain definite advantages; for instance, the normal length of film supplied (in chargers) for the camera being 30 feet (nominal), it is possible to maintain the hobby by "easier payments" than is the case when a longer minimum length must be purchased; moreover, for the occasional cine-photographer the shorter lengths are advantageous in that they enable him to see his results quickly, while the beginner has an opportunity of profiting by his mistakes with a smaller consumption of film.



POPULAR 8-mm. MODEL. For amateurs, cinematography with 8-mm. gauge film is attractive for its cheapness. Above is a suitable camera for this gauge, the Bell and Howell Filmo Double 8, seen in use; this is an American-made model of great popularity on both sides of the Atlantic

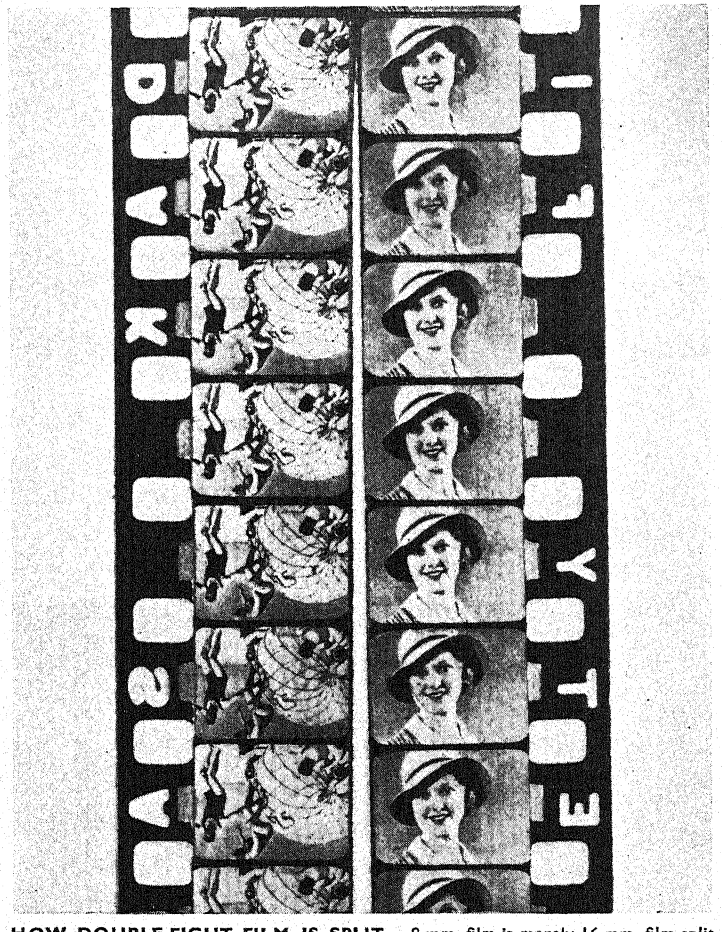
Photo by courtesy of City Sale and Exchange (1929) Ltd. (Fleet Street)

Another advantage is that the films are convenient for home processing, and a range of moderately priced apparatus is available for this purpose. Withal, the 9.5-mm. film is almost as convenient as the 16-mm. for editing and splicing, because the picture image is of a size that can be examined without difficulty.

Although there are some 9.5-mm. cameras which accommodate 50- and 100-feet spools of film, the majority are for use with chargers containing 30 feet or a little less; this is the standard packing. Dufaycolor, for cine-photography in natural colours, is available in the 9.5-mm. gauge.

8-mm. Gauge. The cheapest form of cinematography is to be found in the 8-mm. gauge, where the film cost is but 40 per cent. of that of 16-mm. The apparatus associated with "8-mm." and numerous additional accessories are also lower in cost than equivalent 16-mm. apparatus, but somewhat higher than 9.5-mm.

In the original form, 8-mm. films are actually made on special 16-mm. stock, perforated in the same way as ordinary 16-mm. film but with double the number of perforations. Spools containing 25 feet of this special film are placed in the camera, which



HOW DOUBLE-EIGHT FILM IS SPLIT. 8-mm. film is merely 16-mm. film split along its length in the processing, as shown above. First, one-half of the width of the 25-ft. spool is exposed ; then the spool is removed, reloaded and exposed a second time on its other half. At development the complete spool is slit down the middle, and the two halves joined end to end, 50 feet of 8-mm. film resulting

Courtesy of Kodak, Ltd.

exposes along one-half only of the width. After the film has passed once through the camera the spool is taken out and replaced with the other half width in position for exposure. When both halves have been exposed, the film is returned to the processing station, where it is processed and then slit centrally along its length, the two halves being joined end to end to form 50 feet of 8-mm. film.

This type of film is known as *double-eight*, and is, perhaps, the form most widely used ; but with a view to producing smaller and yet smaller cine cameras a *straight-eight* film has been introduced for use with cameras built specially for single-width 8-mm. film. Needless to say, the straight-eight film is identical with double-eight film which has been slit ready for the projector.

It will be obvious from the foregoing description that single-width 8-mm. film bears perforations along one edge only, and it is a remarkable fact that the actual picture or *frame* is only 5-mm. in width. Further, there are 80 frames to the foot, so that 25 feet of double-eight (or 50 feet of straight-eight) is equivalent in "showing time" to 100 feet of 16- or 9.5-mm. film.

Notwithstanding the almost microscopic dimensions of the 8-mm. frame (*see* Frame, Cine), the quality of picture is so good that it will stand direct comparison with either 16- or 9.5-mm. film, provided no attempt is made to project a picture larger than about 4 feet in width. Provided that no occasion arises for showing a picture larger than this, there is only one objection that may be raised against 8-mm. film ; namely, that it is difficult to handle, and the tiny size of picture renders editing and splicing somewhat tedious unless special viewing and splicing apparatus is installed (*see* Editing ; Splicing Cine Films).

Kodachrome, for making films in natural colour, is available in 8-mm. gauge.

General Notes. In spite of the statement already made that one of the chief factors in popularizing amateur cinematography was the introduction of the reversal process, it would not be true to say that the negative-positive process is extinct in the sub-standard gauges ; it is used to a limited extent, but chiefly in those instances where a number of copies of a film is required. Certainly by far the greater proportion of amateurs use the reversal process, and in

the majority of cases they purchase film which includes in its price the cost of processing and finishing after exposure. In all gauges, however, there are certain brands of film which may be bought without processing rights, and the amateur is then free either to process the film himself or to pay separately for the processing at the time it is required.

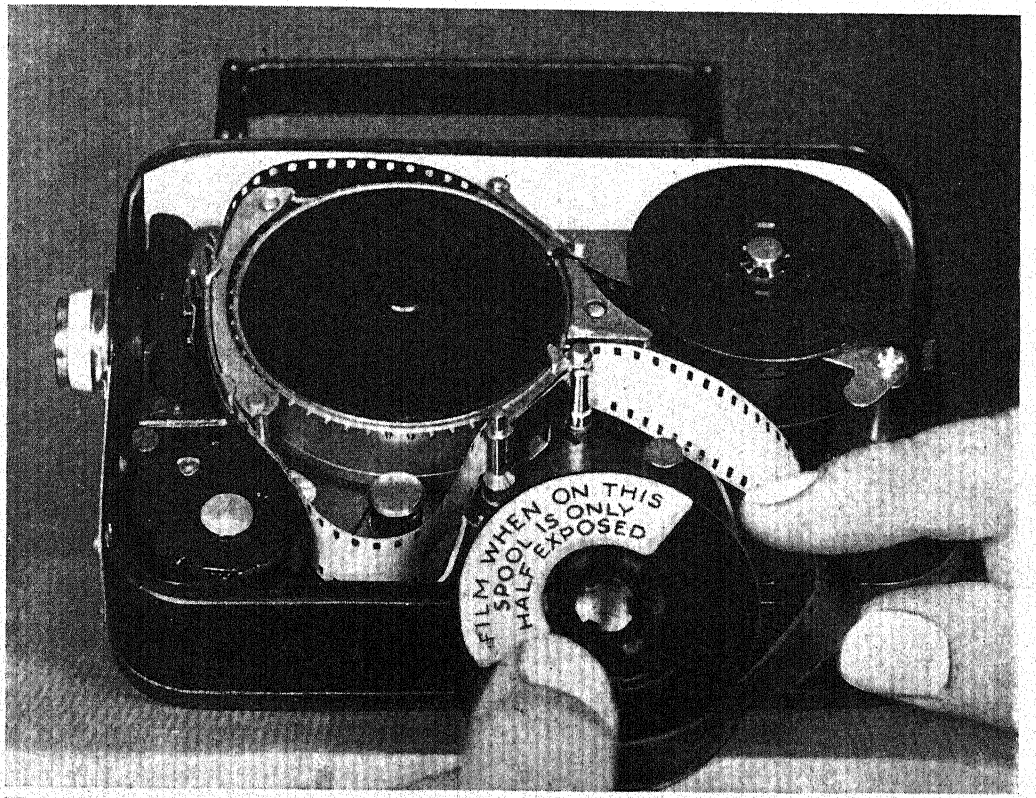
It is worthy of note that a reversal film may be duplicated, and this is an eminently satisfactory method where only a limited number of copies is required ; although, in certain circumstances, it may happen that the duplicated copies are not entirely equal in quality to the original.

Cine Projection. So far the discussion has been based on the assumption that the amateur cinematographer intends to make films as well as project them, and such will be the case in most instances ; but the position is slightly different when the amateur is concerned only with the projection of films for purposes of entertainment, and has no intention of taking up cine camera work.

In these circumstances the 16-mm. gauge still has the advantage, for the reasons already given : that the scope of apparatus and films is comparable with that of the professional cinema ; but, as before, the cost is the highest among sub-standard gauges.

From the point of view of reasonable cost, both in apparatus and the hire or purchase of " library " films, the advantage lies with the 9.5-mm. gauge, particularly as the " home projectionist " is specially well catered for in the matter of library films.

The 8-mm. gauge, however, is not in such a favourable position from the point of view of the home projectionist who is interested only in library films. Although there is a fairly wide selection of films for hire, the charges are somewhat heavier than 9.5-mm. hire charges ; while of films for sale there is a much smaller range. It seems to be the



'FIRST-RUN' LOADING. Clear instructions are given on the spool of the Kodak " Double-Eight " film to simplify the loading process. Film and spool are shown here being placed in position for the first run in the camera. The simplicity of the mechanism is to be noted

Photo, Harold B. Abbott

fact that the 8-mm. gauge is intended first and foremost for the home movie-maker, and that the " library " films are an adjunct, not intended to stand alone.

Amateur Sound Films. By 1937 considerable progress had been made in sub-standard sound films and apparatus, the two available gauges being 16-mm. and the special Pathéscope size of 17.5-mm. Both gauges of film are perforated along one edge only, the sound track occupying the opposite edge.

The making of sound films, however, still remains somewhat too complicated and expensive for the ordinary amateur, although certain amateur cine societies are producing sub-standard sound films. It is chiefly in the projection sphere, however, that sound films have penetrated the homes of amateurs. Excellent sub-standard sound projectors are available, and it is usual to hire the films from libraries.

While a very limited range of apparatus is available for the amateur making sound films of 16-mm., there is no equivalent apparatus for films of 17.5-mm. gauge. Pathéscope Ltd. do, however, market a camera for the making of 17.5-mm. *silent* films, so that the possessor of a Pathéscope Home Talkie Projector may use the instrument for the projection of silent personal films.

This camera is the " Rex " Motocamera. It is equipped with a fixed-focus lens of *f*3, and it has a number of the special features which are embodied in other Pathéscope instruments, such as the enclosed view-finder and film counter.

Sound-on-Disk. In addition to the sound-on-film system which has been discussed, there is also a sound-on-disk system in which sound recorded on gramophone records is synchronized with " silent " films to produce " talkies."

This system can be quite effective, but at present it is chiefly in the hands of individual experimenters, and as far as commercial exploitation goes, sound-on-film holds the field.



SIMPLE MAGAZINE LOADING. The special design of magazine permits the photographer to load the Siemens cine camera with the greatest ease, as demonstrated in this photograph in which gloved hands are being used. The camera is opened, the magazine is dropped into place, and the film is automatically fed into the guide

LIST OF SUB-STANDARD CINE CAMERAS

Once the recreation of a few wealthy amateurs, sub-standard cinematography has, in the last few years, become a popular hobby for an ever-increasing number of people, and amateur cine societies have sprung up all over the country. To assist the newcomer to this field of photography, there follows a carefully compiled list of all the sub-standard cine cameras available in Great Britain

‡ Chargers are frequently called "cassettes" or "magazines."

§ "Fixed" lens mount does not necessarily mean that the lens is of fixed focus ; it may be either fixed focus or focussing, but the lens cannot be removed from the camera.

* This column include. all lenses listed for use with the particular camera, including standard lenses and others which may be purchased as extras. Where two or more lenses are shown in conjunction with "fixed" lens mount, it means that the camera is available with one or other of the lenses, *not* interchangeably.

Cameras Taking 8-mm. Film

NAME	Single or Double Run	Equivalent (single-width) Footage Capacity	§ Lens Mount	* Lens Equipment	Speeds (f.p.s.)	Remark.
AGFA, Movex 8 ...	Single	33 ft.	Fixed	*f*2.8	16	
BELL & HOWELL						
Filmo Double 8 ...	Double	50 ft.	Interch'ble	*f*2.5 12½ mm. *f*3.5 12½ mm. *f*1.4 12½ mm. *f*2.7 1 in. *f*1.5 1 in. *f*3.5 1½ in	8, 16, 24, 32 or 16, 24, 48, 64	
Filmo Straight 8 ...	Single	30 ft	Interch'ble	*f*2.5 12½ mm. *f*1.4 12½ mm. *f*2.7 1 in. *f*1.5 1 in. *f*3.5 1½ in.	8, 16, 24, 32 or 16, 24 48, 64	
DITMAR 8	Double	50 ft.	Fixed	*f*2.5 12½ mm. *f*1.8 12½ mm. (wide-angle and telephoto attachments available)	16, 32	Parallax adjustment to view-finder. Diaphragm aperture and film indicator visible within view-finder. *f*1.8 lens available fixed focus or focussing. Camera also obtainable with built-in photo-cell exposure meter.
KEYSTONE 8	Single and Double	30 ft. (single) 50 ft. (double)	Interch'ble	*f*3.5 13 mm. *f*1.9 13 mm. *f*4.5 1½ in.	12, 16. 48	
KODAK						
Cine-Kodak Eight-20	Double	50 ft.	Fixed	*f*3.5 12½ mm. (fixed focus) or *f*1.9 13 mm. (focussing)	16	
Cine-Kodak Eight-60	Double	50 ft.	Interch'ble	*f*1.9 13 mm. *f*4.5 1½ in.	16	Telephoto lens panel carries an appropriate mask for view-finder.
PAILLARD-BOLEX, H8	Double	50 ft. (will take up to 200 ft. when 100 ft. double-run films are available)	Turret for 3 lenses (interch'ble)	12½ mm. 25 mm. 36 mm	8, 16, 24, 32, 64 and intermediate ; also single-picture	Semi-automatic loading. Parallax-compensated view-finder from 2 ft. to infinity. Visual focusser. Hand rewinding for double-exposure, etc.
SIEMENS, C8	Double	50 ft.	Fixed	*f*2.5 13 mm.	8, 16, 24, 64	Automatic aperture control adjusts iris diaphragm when changing speeds.
ZEISS-IKON, Movikon 8	Single and Double	30 ft. (single) 50 ft. (double)	Interch'ble	*f*2 10 mm. (fixed focus) *f*2.7 20 mm. (focussing)	8, 16, 64 ; also single-picture	Delayed action release (for self-portraiture). Predetermined footage regulator for delayed action. End-of-film signal in view-finder. View-finder may be used at right-angles.

Cameras Taking 9·5-mm. Film

NAME	‡ Charger or Spool-Loading	Capacity	§ Lens Mount	* Lens Equipment	Speeds (f.p.s.)	Remarks
CORONET, Model B	Charger	30 ft.	Fixed	*f*3.9 27 mm.	16	
DEKKO						
"Standard" ...	Charger	30 ft.	Interch'ble	*f*3.5 20 mm. *f*2.5 23 mm. *f*2.9 1 in. *f*1.9 1 in. *f*1.5 1 in. *f*3.5 3 in. *f*4 3 in.	8, 16, 32, 64 and intermediate ; also single-picture	Black bakelite body.

List of Sub-Standard Cine Cameras (9.5-mm.)—*cont.*

DEKKO "De Luxe"	Charger	30 ft.	Interch'ble	*f*2.5 23 mm. *f*1.9 1 in. *f*1.5 1 in. *f*3.5 3 in. *f*4 3 in.	8, 16, 32, 64 and intermediate; also single-picture	Aluminium die-cast body, finished black. Parallax adjustment to view-finder.
DITMAR, 9.5	Charger	30 ft.	Fixed	*f*2.9 20 mm. (fixed focus) *f*1.8 20 mm. (focussing); wide-angle and telephoto attachments available.	16, 32	Parallax adjustment to view-finder. Diaphragm aperture and film indicator visible within view-finder. Camera also obtainable with built-in photo-cell exposure meter. *f*2.8 lens also available, focussing.
Ditto	Spool	50 ft.	Fixed	(*as above*)	16, 32	(*As above.*)
PAILLARD-BOLEX, H9	Spool	50 or 100 ft.	Turret for 3 lenses (interch'ble)	*f*1.5 1 in. *f*2.9 1 in. *f*1.5 15 mm. *f*2.9 15 mm. *f*1.5 2 in. *f*2.9 2 in. *f*3.5 3 in. *f*3.5 4 in. *f*3.5 6 in.	8, 16, 24, 32, 64 and intermediate; also single-picture	Semi-automatic loading. Parallax compensated view-finder from 2 ft. to infinity. Visual focusser. Hand rewinding for double-exposure, etc.
PATHÉSCOPE Motocamera "H"	Charger	30 ft	Interch'ble	*f*2.5 20 mm. (fixed focus) *f*1.9 25 mm. (focussing) *f*3.5 2 in.	16 and single-picture	Special Type "H" chargers are available for use with this and other models.
De Luxe Moto-camera	Charger	30 ft.	Fixed	*f*2.5 20 mm. (telephoto attachmen available)	10 to 20	End-of-film warning device visible in view-finder. View-finder adjustable for waist-level use.

Cameras Taking 16-mm. Film

NAME	‡ Charger or Spool-Loading	Capacity	§ Lens Mount	* Lens Equipment	Speeds (f.p.s.)	Remarks
AGFA						
Movex 12	Charger	40 ft.	Fixed	*f*3.5 20 mm.	16	"Two-distance" focussing, for (*a*) near, and (*b*) distant views.
Movex 30B	Spool	50 or 100 ft.	Interch'ble	*f*1.5 20 mm. *f*2.8 20 mm. *f*3.5 50 mm. *f*3.5 80 mm. *f*3.5 4 in.	8, 16, 24, 32	
BELL & HOWELL						
Filmo 75	Spool	50 or 100 ft.	Interch'ble	*f*3.5 20 mm. *f*2.7 1 in. *f*1.8 1 in. other lenses (up to 4 in.) as for Filmo 70-D	16	
Filmo 121	Charger	50 ft.	Interch'ble	*f*2.7 1 in. *f*2.5 15 mm. *f*1.5 1 in. other lenses (up to 4 in.) as for Filmo 70-D	16, 24 and single-picture	Eye- and waist-level view-finders.
Filmo 70-E	Spool	50 or 100 ft.	Interch'ble	*f*2.7 1 in. *f*1.5 1 in. other lenses as for Filmo 70-D	8, 16, 24, 64	
Filmo 70-D	Spool	50 or 100 ft.	Turret for 3 lenses (interch'ble)	*f*2.7 1 in. *f*2.5 15 mm. *f*1.5 1 in. *f*1.8 1 in. *f*3.5 2 in. *f*4 3 in. *f*4.5 4 in. *f*4.5 6 in. *f*5.5 6 in.	8, 12, 16, 24, 32, 48, 64 and single-picture	View-finder adjustable to match lenses of six different focal lengths. Critical focusser. May be adapted, by adding accessories, for hand-crank, electric motor drive, 200- or 400-ft. external film magazines, etc., etc.
DeVRY "60"	Spool	100 ft.	Interch'ble	*f*3.5 20 mm. (fixed focus) *f*3.5 1 in. *f*2.5 1 in. *f*1.8 1 in. *f*1.5 1 in. *f*4.5 3 in.	16	

List of Sub-Standard Cine Cameras (16-mm.)—*cont.*

DITMAR 16	Spool	50 ft.	Fixed	*f*2.8 20 mm. (fixed focus) *f*2.8 20 mm. (focussing) *f*1.8 20 mm. (focussing): wide-angle and telephoto attachments available	16, 32	Parallax adjustment to view-finder. Diaphragm aperture and film indicator visible within view-finder. Camera also obtainable with built-in photo-cell exposure meter.
ENSIGN						
Simplex Pockette	Charger	50 ft.	Interch'ble	*f*3.5 1 in. *f*2.9 1 in. *f*1.9 1 in.	12, 16 also single-picture	Predetermined footage regulator can be set to stop automatically camera when desired footage (up to 25 ft.) has been exposed.
Kinecam 6	Spool	50 or 100 ft.	Interch'ble	*f*2.8 1 in. *f*1.5 1 in.	8, 16, 64	Hand and motor drive. Reverse (or rewind) action by hand crank. Additional axial finder with parallax adjustment.
Kinecam 8	Spool	50 or 100 ft.	Turret for 3 lenses (interch'ble)	*f*2.8 1 in. *f*1.5 1 in. *f*2.9 20 mm. *f*2.9 2 in. *f*1.9 2 in. *f*3.5 3 in. *f*4.5 4 in.	8, 12, 16, 32, 64	Special "tri-optic" view-finder with three combinations to suit lenses of different focal lengths. Hand and motor drive. Reverse action by hand crank.
KEYSTONE A-3 ...	Spool	50 or 100 ft	Interch'ble	*f*3.5 1 in. *f*1.5 1 in. and telephoto	8, 16, 64 and intermediate speeds	
KODAK						
Cine-Kodak BB Junior	Spool	50 ft.	Fixed	*f*3.5 20 mm. (fixed focus) or *f*1.9 1 in. (focussing)	16	
Cine-Kodak K ...	Spool	50 or 100 ft.	Interch'ble	*f*1.9 1 in. *f*3.5 2 in. *f*2.7 2½ in. *f*4.5 3 in. *f*2.7 4 in. *f*4.5 4½ in. *f*4.5 6 in. *f*2.7 wide-angle	8, 16	Standard view-finder attached to standard and wide-angle lens panel and removed therewith. Special view-finder attached to interchangeable panel for other lenses.
Magazine Cine-Kodak	Charger	50 ft.	Interch'ble	As for Cine-Kodak K	8, 16, 64	Adjustable view-finder to suit all lenses.
Cine-Kodak Special	Inter-changeable film chambers	50, 100 or 200 ft.	Turret for 2 lenses (inter-changeable)	As for Cine-Kodak K	All speeds from 1 to 64 f.p.s.	A semi-professional camera capable of special effects and adaptation to almost any requirements.
PAILLARD-BOLEX, H16	Spool	50 or 100 ft	Turret for 3 lenses (inter-changeable)	*f*1.5 1 in. *f*2.9 1 in. *f*1.5 15 mm. *f*2.9 15 mm. *f*1.5 2 in. *f*2.9 2 in. *f*3.5 3 in. *f*3.5 4 in. *f*3.5 6 in.	8, 16, 24, 32, 64 and inter-mediate; also single-picture	Semi-automatic loading. Parallax compensated view-finder from 2 ft. to infinity. Visual focusser. Hand rewinding for reverse action, double-exposure, etc.
SIEMENS						
Model "B"	Charger	50 ft.	Fixed	*f*2.8 20 mm.	8, 16, 64 and single-picture	Automatic aperture control adjusts iris diaphragm when changing speeds. "Two-distance" focussing for (*a*) near and (*b*) distant views. Free-wheel release to discharge motor spring without moving film.
Model "C"	Charger	50 ft.	Fixed	*f*1.5 20 mm.	8, 16, 24, 64 and single-picture	Automatic aperture control. Depth of focus scale. Free-wheel motor release. Provision for attaching range-finder (not coupled).
Model "F"	Charger	50 ft.	Interch'ble	*f*1.5 1 in. *f*1.9 1 in. *f*2.3 2 in. *f*2.8 3 in. *f*3.8 3 in. *f*3.8 4 in. *f*4.5 6 in. *f*5.5 6 in. *f*6.8 8 in. and wide-angle	8, 16, 24, 64 and single-picture	Free-wheel motor release. Holder for range-finder. Dallmeyer *f*1.5 speed lens also obtainable.
Model "D" ...	Charger	50 ft.	Sliding panel for 3 lenses (interch'ble)	*f*1.5 1 in., also as for Model "F"	8, 16, 24, 64 and single-picture	Automatic view-finder adjustment for various lenses. Free-wheel motor release. Holder for range-finder.
VICTOR						
Model 3	Spool	50 or 100 ft.	Interch'ble	*f*2.9 1 in *f*1.5 1 in. also 2 in., 4 in., 6 in., and wide-angle	8, 16, 24 32, 64	Parallax adjustment to view-finder. Hand crank in addition to motor drive.

List of Sub-Standard Cine Cameras (16-mm.)—*cont.*

VICTOR						
Model 4	Spool	50 or 100 ft.	Turret for 3 lenses (inter-changeable)	*f*2.9 1 in., also as for Model 3	8, 16, 24 32, 64	Visual focussing and adjustable view-finder, with decentralizing arrangement. Hand and motor drive. Film indicator accurate to 3 frames per 100 ft.
Model 5	Spool	50 or 100 ft.	Turret for 3 lenses (inter-changeable)	*f*2.9 1 in. also as for Model 3	8, 16, 24, 32, 64	Visual focussing and adjustable view-finder, with decentralizing arrangement. Hand and motor drive. Reverse (or rewind) action by hand crank. Film indicator accurate to 3 frames per 100 ft.
ZEISS-IKON						
Movikon 16	Spool	50 or 100 ft.	Interch'ble	*f*1.4 1 in. also *f*2.7 15 mm. *f*2.7 20 mm. *f*2.8 2 in. *f*4 3 in. *f*6.3 7 in.	12, 16, 24, 64 and single-picture	Range-finder coupled to lens. Provision for direct focussing on film. Automatic parallax adjustment to view-finder. Right-angular view-finder. End-of-film signal in view-finder tube. Automatic delayed action (self-portraiture). Predetermined footage regulator for delayed action. Reverse (or rewind) by hand crank. Adjustable shutter speeds of 1/25 to 1/1000 sec.

CARE OF THE CINE CAMERA

The minor adjustments and small repairs that a well-used cine camera may need are here described in a thoroughly practical manner, with instructions for avoiding the recurrence of unnecessary troubles

Annual overhauls are usually bestowed upon "still" cameras. Cinematograph cameras, however, fall into a different category. They may not be so frequently used as the comparatively inexpensive "still" instruments, and—quite apart from the protective influence of the camera case—they are almost completely dustproof. Moreover, the cine worker habitually cleans the more vital parts of his instrument (lest poor definition or an accumulation of film "wool" around the frame of the gate impairs the technical execution of his work).

Dust and Grit

For these reasons, it might be thought that the necessity for a thorough overhaul is less urgent; but, on the other hand, it must not be forgotten that the cine camera can create its own internal dust by reason of the highly involved mechanical action. After holidays this is likely to have been augmented by accumulated dust and grit—strong reason for getting on with the cleaning at once, and not waiting until two or three winter pictures have been spoilt.

Internal Cleaning

For obvious reasons, a start should be made with the internal parts of the camera. After opening the cover it should be ascertained that the locking mechanism is in thorough order and does not move too freely. Then the empty take-up spool should be removed and the gate mechanism unscrewed. This will leave the film channel and pressure-pad easily accessible for cleaning and for any necessary reburnishing.

On no account, however, should these parts be polished unless irregularly worn or damaged. Metal polish, sometimes recommended, may scratch.

With the gate out of the way the lens may be unscrewed from the front and any free dust removed from the shutter cavity with the aid of a bicycle pump. Any internal lubrication pads may be given just a drop or two of oil, though not all cameras have these pads—one amateur machine having none of the familiar intermittent actions, whilst a recently invented professional camera has neither shutter nor intermittent.

The plate concealing the driving spring and control mechanism should not be tampered with. Admittedly, there is dust enough on the other side; but the plate is quite effective in keeping it there. It is hardly ever necessary to re-lubricate the internal spring, but where the camera is an old one it may be cleaned by the manufacturers.

Finally, the interior walls of the camera should be cleaned with a duster moistened in kerosene. Any parts of the interior that have rubbed bare should be dabbed with a little matt-black varnish and allowed to dry.

After replacing the internal parts and seeing that everything is moving freely, the cover may be replaced and locked.

Then, before screwing the lens into its flange, attention should be directed to the

view-finder. If this be of the tubular type, both the eyepiece and the remote attachment should be removed and the tube carefully dusted out with a fine piece of silk used as a " pull-through." The lenses may then be more carefully cleaned than is customary during filming operations. Dust may have accumulated at the edges near the mounts, and this also may be removed with silk.

The fixed winding-key and the keyholes (there are two in the case of certain instruments like the " Victor " and others) may possibly be harbouring dust and pieces of fluff. These may be removed with a small hair brush. No attempt should here be made to polish any of the bright metal parts on the outside of the camera ; they will tarnish again even more quickly, and it is difficult, besides, to avoid smearing the blackened body of the instrument with the polish.

The general exterior of the camera may be cleaned with a kerosene-dampened cloth, after which any scratches or chips on the enamel may receive attention. Owing to the surface irregularity in the popular crystalline finishes, it is comparatively easy to remedy chips and scratches by the mere expedient of filling up the defects with quick-drying matt black, applied on the point of a fine brush.

After this, the outer surfaces of the lens may be polished with the usual well-worn piece of fine silk or chamois leather.

Sub-standard cine lenses are things even more delicate than ordinary photographic lenses, and it is only meet that they be treated accordingly.

The camera is now ready for another long spell of efficient service, but steps must be taken to avoid any further immediate contamination. Ordinarily, there is no better way of ensuring protection than to put the instrument back into its case. But now the case is in all probability very much dirtier than the camera, and may itself prove an annoying cause of contamination.

CINEMATOGRAPHY FOR THE AMATEUR: (2)

Hints and Methods for the Beginner in Sub-Standard Work

Harold B. Abbott

Author of ' The Complete 9.5-mm. Cinematographer '

How *not* to use the cine camera is as important as how to use it, for most of the beginners' errors are of commission rather than omission. Below, the first principles of amateur film-making are enunciated with perfect clarity, and much time and film will be saved by the beginner who masters them

THERE are three main stages in the evolution of an amateur cinematograph cameraman. In the first stage he uses his camera much in the same way as he would use a " snapshot " camera, *i.e.* he films a variety of unconnected subjects and joins them together to form a disjointed reel. The finished reel is somewhat akin to the promiscuous photograph album, but with the addition of movement to each " snapshot."

Acquaintance with other amateur cameramen, or with the literature of amateur cinematography, brings to light the fact that motion pictures should tell a story, and this induces the amateur to enter upon the second stage of evolution, wherein he seeks to impart " continuity " into his films — to make sequences in which consecutive " shots " are made to tell a story or an anecdote. These anecdotes may also be made up into a reel which is somewhat promiscuous, but the true principle of film-making has been discovered, and the personal " gazette " or magazine, properly produced, is entitled to be considered as good cinematography.

The third stage is that of the advanced worker who makes a keen study of the amateur film as an art. His film must have continuity from start to finish ; every shot to be made is studied carefully in regard to its place not only in the sequence but in the film as a whole. Moods and emotions are carefully regulated by the juxtaposition as well as the content of the shots and sequences, and rhythm is imparted by skilful cutting.

The purpose here is to show the beginner how to reach the intermediate stage. The more advanced aspects are dealt with in the following section on Advanced Methods.

The working of the camera, how to load it with film, and the simple mechanical



ENSIGN SIMPLEX POCKETTE. A 16-mm. cine camera embodying a special charger which carries 50 feet of film. It is equipped with folding direct-vision finder, which is shown here

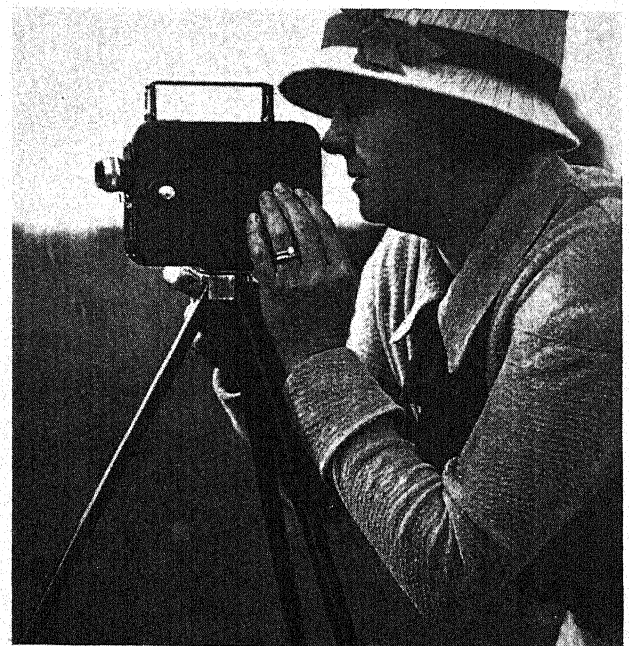
movements necessary to operate it are fully explained in the instruction booklet accompanying every instrument. Inasmuch as the normal amateur cine camera has one fixed shutter speed, the method of regulating the light passing through to the film, in order to secure correct exposure, is to vary the aperture by means of the iris diaphragm which is built into the lens. Certain definite settings of the diaphragm are marked on the diaphragm scale, each calibration being known as a "stop" or "*f* number." These stops are so calibrated that each lower number admits exactly twice the amount of light of its neighbouring higher number.

Some sort of exposure guide is usually incorporated in the instruction booklet, but the beginner should acquire an exposure meter, the most effective type being the "photo-electric" exposure meter.

Correct Use of Cine Camera. There are two simple but very important rules to remember when operating a cine camera. In the first place it must be held absolutely steady, *i.e.* free from tremor or vibration; and, secondly, it must be kept still, *i.e.* it must not be swung round, or to and fro, in order to encompass a scene too large for the limits of the view-finder or to follow the movement of an object. The use of a good tripod is to be recommended wherever such a course is possible; but when a tripod is not used the camera should be pressed against the face while the body takes up a firm but comfortable stance, unless a firm, level position on a rock or wall is chosen.

Every beginner has a natural tendency to swing his cine camera about in an effort to keep a moving object within the view-finder, but the result on the screen is most distressing. By adopting a viewpoint whereby the moving object approaches more or less directly towards the camera, the object may be kept in view for a sufficient length of time, without moving the camera, and the result is much more effective than that achieved by "hose-piping."

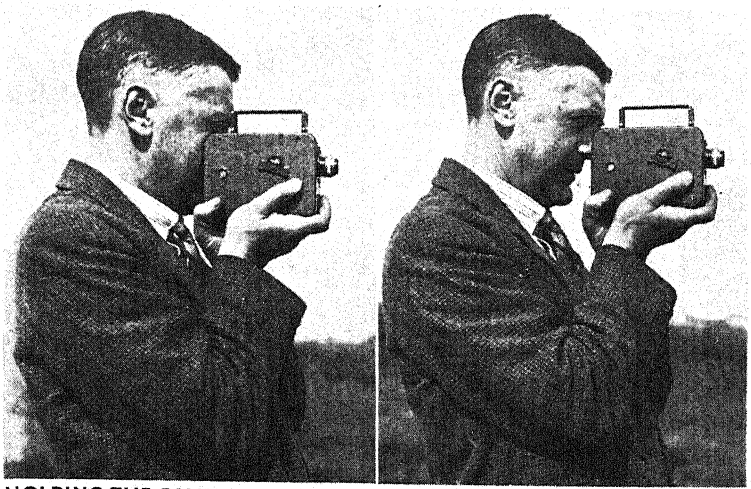
The placing of the camera in relation to the subject is a matter to which the amateur cameraman should give very careful attention. It is usual to indicate the relative camera position by such terms as Distance Shot, Long Shot, Mid Shot, Close-Up, and Big Close-Up : these are frequently



TRIPOD MOUNTING. Whenever possible the amateur should use a good tripod with his cine camera since the rigid mounting gives more accurate and steadier filming

Photo, Harold B. Abbott

abbreviated to D.S., L.S., M.S., C.U., and B.C.U. There is no hard-and-fast definition of these terms, but they are sufficiently expressive to acquaint the cameraman with the size, or scale, of the subject in relation to the picture space. The small reproductions in page 320 illustrate the usually accepted interpretation of the terms, and it will be obvious that the different "scales" depend upon the distance the camera is placed from the subject.



HOLDING THE CAMERA. Left: By pressing the camera against the face, vibration and tremor are minimized. Right: Elbows against the body and camera well held, but absence of facial support results in unsteadiness

Photos, Harold B. Abbott

One of the commonest failings of beginners' films is the habitual use of the Long Shot, in which the camera is set up to embrace an ample view. In part this may be due to the use of a fixed focus camera, which, the beginner is told, may only be used to film subjects beyond a certain distance from the camera ; but in the main the habit of filming everything in long shot is due to a lack of appreciation of the value of the close-up.

Any fixed focus camera may be used for filming close-ups ; it is only necessary to



EFFECT AND VIEWPOINT. A viewpoint which entails swinging the camera when filming a moving object should be avoided as much as possible. Much better effects are obtained by adopting a position where the object approaches more or less directly towards the camera. The contrasting results are shown in these two stills. With a little imagination the effect of movement at the two angles shown is easily realized

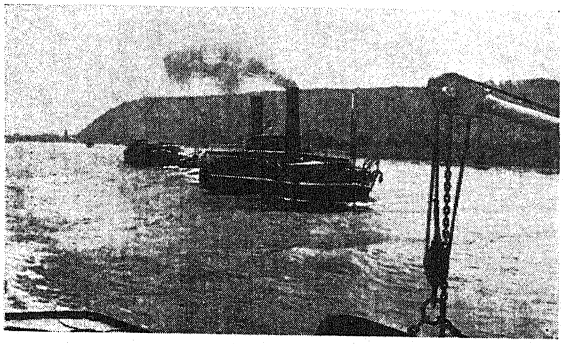


Fig. 1



Fig. 2

CINE SHOTS. Fig. 1. Distance Shot (D.S.). Fig. 2. Mid Shot (M.S.). Fig. 3. Close-up (C.U.). Fig. 4. Big Close-up (B.C.U.). These terms are universally used in cinematography and are further explained in the text



Fig. 3



Fig. 4

slip an appropriate " portrait attachment " over the lens, and these attachments are available for practically every fixed focus cine camera.

The portrait attachment is suitable for one fixed distance only, but it is usual for manufacturers to issue a series covering distances of 1½ ft., 3 ft., and 6 ft., after which latter distance the camera may be used without portrait attachments. Cameras with focussing lenses do not require portrait attachments because the camera lens may be focussed for any distance between 2 ft. (in some cases 1½ ft.) and infinity.

The beginner should impress upon his mind the valuable power which the cinematograph possesses of being able to *develop a theme.* It is quite unnecessary to depict the whole of an action in one " shot " because the progressive nature of the motion picture film enables the camera to examine the action in detail and submit a full report of what it has " seen." Moreover, the detailed report will be a far more vivid and interesting document than the " general survey " of the long shot, but more film is consumed by the " development."

An example of a very simple shot such as any beginner might " take " is that of a drinking fountain in a country town, with a couple approaching it and drinking some water. The beginner probably would take up a position some 25 ft. from the fountain in order to " get it all in " and, from this position, would film the whole action of the couple walking up to the fountain, drinking and then departing. The time taken by these actions might be anything from 30 to 40 seconds and it is probable that the cameraman, becoming alarmed at the consumption of film, would stop the camera abruptly before the action was finished. In any case, this film would contain nothing of sufficient interest to justify its cost.

A better method is to split the subject up, when the camera will " submit a full report " of the details, such as

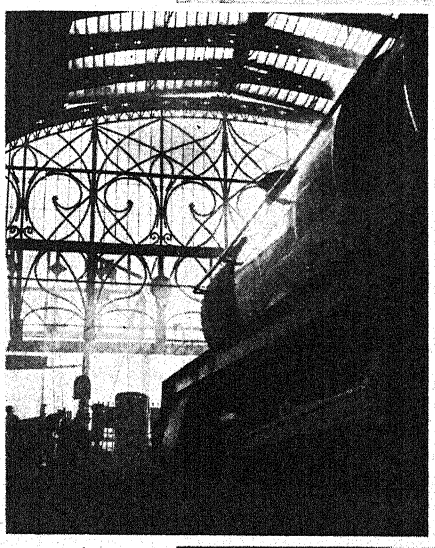
A GOOD CINE SEQUENCE. Here are six stills of individual shots which could be linked up in logical sequence

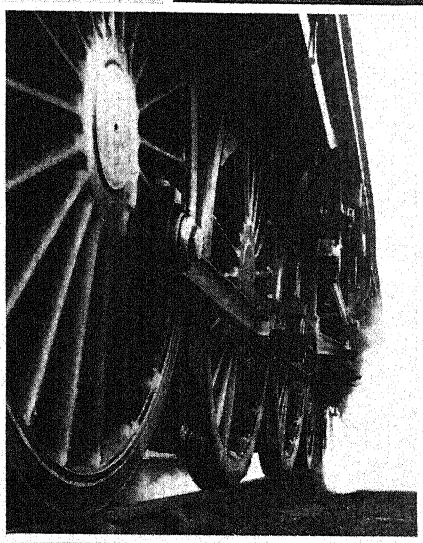




Left, an angle shot at the platform barrier and (right) prelude to the journey

Photos, left, Fox; right, J. D. Pearson

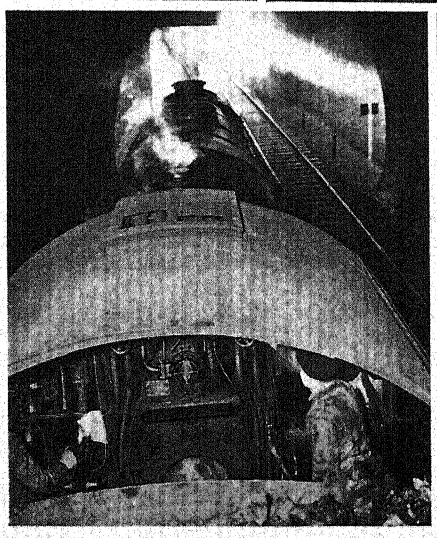


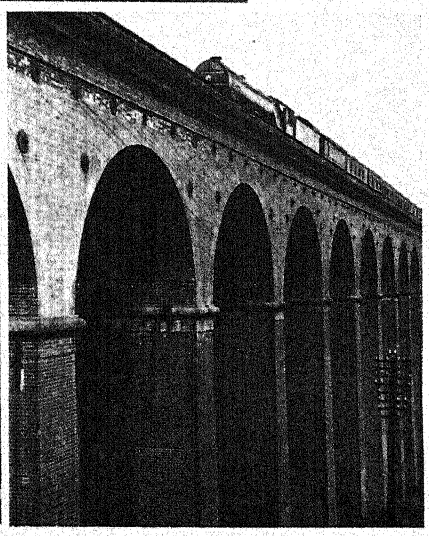


Left, the journey starts. An impressive angle shot taken as the engine leaves the station

Right, a close-up of the locomotive's driving wheels would emphasize the theme

Left, a further shot taken from the engine which could be employed to prolong and stress the departure scenes





Right, the train en route taken at long range. Such a shot could be included to maintain the continuity with good effect

follows (note the approximate duration of each " shot ") :

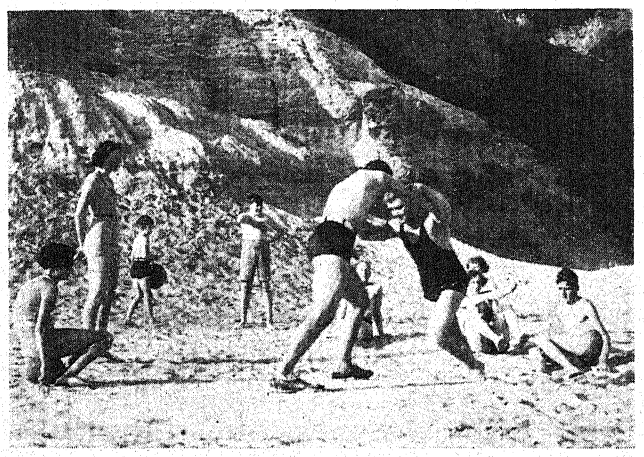
		Secs.
L.S.	The drinking fountain; couple walking towards it	4
C.U.	The drinking fountain; couple walk into picture and one picks up a drinking cup..	5
B.C.U.	The tap; a hand is holding a cup to it while another presses the plunger of the tap; water squirts into cup	3
C.U.	One of the couple takes a drink ..	4
C.U.	The other looks thirstily in the direction of the drinker	3
M.S.	The couple at the fountain; the second one is now drinking; he finishes, and both walk out of the picture	5
	Total 24 seconds	

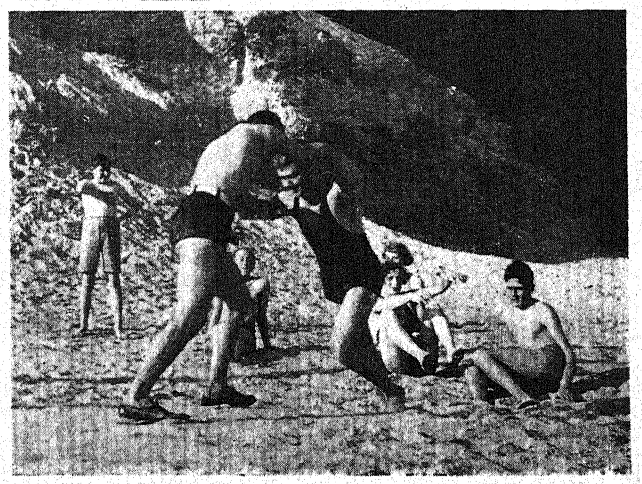
The subject matter of this " anecdote " may appear somewhat trivial for so " elaborate " a treatment but, assuming the film is a personal one, the treatment has made the anecdote worth while, and it will be found interesting on the screen. Incidentally it has shown a considerable saving of film and enabled the action to be completed. That example is intended merely as an illustration of the correct use of a cine camera, and the amateur who will apply the general principle as far as possible to every subject he films will find a much greater interest in the hobby, even though he may have no intention of proceeding beyond family and personal interest films.

Type and Treatment of Subject. When making films of the " portrait " type, the amateur should always give the sitter something to do. For " still " photography it may be a quite satisfactory proceeding to sit the subject on a chair and tell him or her to smile, but in motion picture work this is far from satisfactory. Let the sitter (who may stand if necessary) do some knitting, or water the garden, pick some flowers or play with the dog—anything that involves movement and gives the sitter an opportunity of being natural.

Cinematography is essentially the portrayal of *motion*, and unless motion of some kind is in evidence in a shot, the latter quickly palls; therefore, though it may sometimes be necessary to include a more or less static shot in a film, the occasions should be strictly limited and the actual duration of static shots should be kept short.

Often a static subject may be greatly improved by being " split up " into a number of short shots taken from different angles and varying from distance shots to close-ups. Old buildings and similar subjects can frequently be dealt with effectively in this way. When changing from a distance shot to long shot, or from a long shot to a mid shot, it is advisable to change slightly the angle, or viewpoint, or the effect will be of the object having jumped forward, or of its changing rapidly in size like an Alice in Wonderland figure.



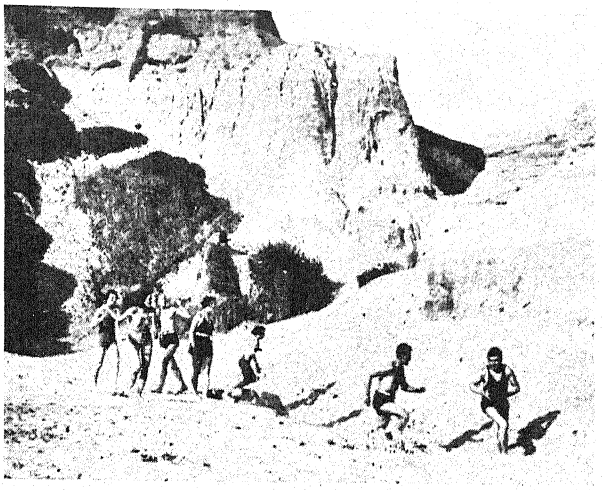


CLOSER INSPECTION. By the use of a medium shot, at the right, following a long shot, as above, the amateur film attains a distinctly professional touch. It is also used to focus the attention on to the main characters in a scene

Photos, David Charles

Distant views are generally unsuitable for the cinematograph; but occasionally they may be justified provided they are linked in some way with a prominent foreground object. Without such object of interest in the foreground distant views invariably appear weak and unimpressive on the screen.

The most satisfactory subjects undoubtedly are those in which a reasonable amount of movement or action takes place within a comparatively short distance of the camera, and such subjects





AVOIDING MONOTONY. By breaking up a film into a sequence of short shots from varying angles and distances, the interest of the audience can be maintained. Remember it is more economical to do this when "shooting" than in the editing stage

Photos, David Charles

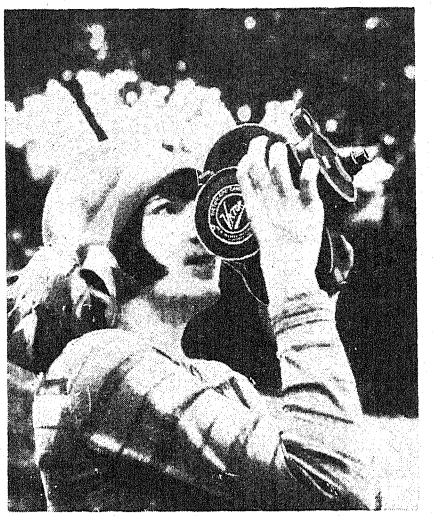


are usually best dealt with by adopting a more or less standard "treatment." First, the locality is "established" by exposing a short length of film from a distance sufficient to embrace the immediate surroundings in which the action is taking place. The camera is then moved forward until a "long shot" position is reached, when a further exposure is made, of a duration sufficient to convey the general action. The interesting or important details of the action are then noted and the camera is taken closer to record mid-shots or close-ups of these details. It will be observed that this is exactly the treatment accorded to the imaginary drinking-fountain sequence described earlier.

When the amateur has succeeded in producing satisfactory little sequences or anecdotes he may consider himself qualified to embark on slightly more ambitious productions, wherein the sequences themselves are linked together to form a short story. The term "story" in this connexion is not intended to imply a photo-play with fictitious characters; it infers merely a connected and rational account of some phase of activity

which might be a holiday, an outing, the running of a poultry farm, a day in the life of a river policeman, or any other subject which could be made into an interesting film.

For projects of this kind it is essential to plan the film beforehand, carefully working out on paper the " shape " of the story and, as far as possible, the items which shall be photographed and the manner in which the story shall progress from one incident to another. It is practically impossible to make an entirely successful film of this type without such preparation.



VICTOR THREE. This American cine camera has a high-quality Dallmeyer triple anastigmat f 2.9 one-inch universal focus lens, and takes 16-mm. gauge film. It is one of the most popular amateur cine cameras in the U.S.A.

Avoiding Sub-Titles. The whole purpose of the cinematograph is to tell a story in pictures, and the amateur should make it a cardinal rule that nothing which can reasonably be pictured shall be left to a sub-title. Sub-titles are a necessary evil, but they may be kept to a minimum by the cameraman who *thinks in pictures*. Phrases such as " We went to the Zoo " are more suitable for a diary than a film. It is easy enough to illustrate the fact that one went to the Zoo, and the camera should be used to record one's going, so that the sub-title is unnecessary.

By way of example : the party might be shown waiting for and boarding a bus. Next the entrance to the Zoo is filmed from a distance that permits the inclusion of a bus which is pulling up at the entrance. A close-up of the party leaving the bus shows that one of the members is pointing to something —and this proves to be (B.C.U.) a signboard : " ZOOLOGICAL GARDENS."

Sub-titles should be limited to those occasions when it is necessary to explain something, or bridge a gap, which cannot well be illustrated.

Use of Variable Speeds. While many of the simpler cine cameras are limited to one speed of operation—the normal 16 frames per second—there are others in which the speed may be varied between 8 and 64 f.p.s. This additional facility is very useful on occasions, quite apart from " stunt " effects. For example, the half-speed movement (8 f.p.s.) may be used to give increased exposure when the light is too weak for normal exposure.

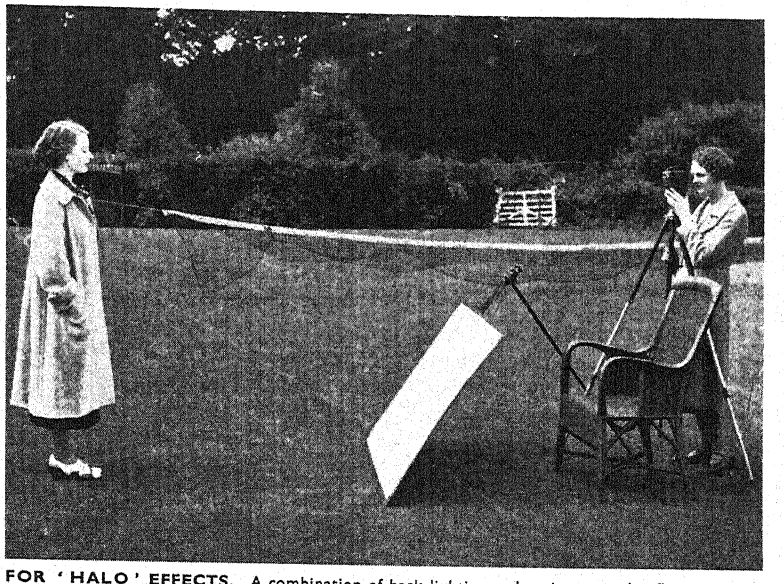
The use of half-speed has the effect of *doubling* the speed of action when the film is projected, and it is essential that this aspect be considered when filming the subject. In certain circumstances the increased rate of movement may not be objectionable, but with normal action of reasonable vigour the result might well be ludicrous, and in such cases it is obvious that the original action should, if possible, be slowed down to half-speed in order to compensate for the slow running of the camera.

Half-Speed and Double-Speed. There are sometimes occasions on which the accelerated motion imparted by half-speed may be utilized to advantage ; for example, when filming some action wherein the rate of movement would normally appear too slow upon the screen. Instances of such cases are to be found in subjects of movement taking place at a distance, of ships and approaching or receding shores, of cloud movements, and ponderous movements of bridges, cranes, etc., and in pictures where a comic effect is desired.

The use of half-speed demands a rigidly mounted camera, a stop (or diaphragm aperture) smaller than that which is normally used, and a duration of twice normal (since the film will run through the projector in one half the time it took to run through the camera).

Double-speed (32 f.p.s.) is useful when it is desired to retard an action, *e.g.* machinery which may be working too fast for its action to be intelligible if photographed at normal speed ; or fast-moving vehicles at fairly

close range. One of the results incidental to the use of double-speed movement is a lessening of the effect of camera vibration; for this reason double-speed may often be used with advantage when filming from a moving vehicle. It is obvious that twice the normal amount of film is used in a given time, and the cameraman should bear in mind the fact that the projection time will be twice the duration he devotes to shots taken at double speed.



FOR 'HALO' EFFECTS. A combination of back lighting and an interposed reflector can be used to obtain a 'halo' effect around the subject's head. The hair is lit up by the light from behind, and the reflector throws the light on to the face, which would be otherwise in shadow

The iris diaphragm must be opened one "stop" wider than normal when filming at double speed.

Quadruple speed (64 f.p.s.) allows semi-slow motion to be adopted for analysis of movement. It is a speed that has a very limited application from the beginner's point of view, and should be restricted to those occasions when it is desired to study in detail some form of motion. For occasional humorous effects quadruple speed may prove useful, but it is apt to be wearisome if repeated too often or if the shots are "held" too long. In this latter connexion it must be remembered that for every second the camera works at 64 f.p.s. the resultant film occupies the screen for four seconds. Quadruple speed necessitates opening the iris diaphragm two stops above normal.



SET-UP FOR FRONT LIGHTING. Cine portraits taken with natural lighting can be made brighter and more effective by placing a reflector in front of the subject, as shown here. The reflector consists of a board with a white or silvered surface

Photos, H. A. V. Bulleid

A "single picture movement" is sometimes incorporated in amateur cine cameras, and its purpose is to enable a single frame (*see* Frame, Cine) to be exposed at each pressure of the release button. This movement is very useful for trick pictures, including cartoons and "animation," wherein an

inanimate object is made to appear to move by photographing stages of slight changes in position. The single picture movement is also much used for " effects " in making titles, but it has not a wide application in the normal use of the cine camera. There are occasions, however, on which it may be used to speed up extremely slow movements in nature, and examples which have been suggested are the movement and changing formations of clouds, the setting sun, and so forth. In such cases a single frame is exposed at regular intervals (*e.g.* one per second). The result is obviously false, but in certain circumstances it may indicate the restless forces of nature.

Interchangeable Lenses. Cameras which have interchangeable lens mounts, or turret fronts, afford an opportunity of using lenses of different focal lengths. The normal lens supplied with the camera is a general purpose lens, suitable for the great majority of subjects ; but there are occasions on which it is an advantage to be able to change the lens for special purposes.

For example, for occasions when it is impossible to get far enough back to include the whole of a desired subject (*e.g* in interior work), a short focus lens enables a wider angle to be included. On the other hand, when it is impracticable to approach a subject as close as may be desired, a long focus lens will restrict the angle and render a larger image of any selected portion of the subject. In other words, the long focus lens acts like a telescope, and the " power " or magnification of the lens, as compared with the normal lens, is in direct ratio to its relative focal length.



ADJUSTING THE FOCUS. A focussing camera is adjustable for all distances, but may be used as a fixed-focus instrument if set between 15 feet and 20 feet with the iris diaphragm at an aperture not larger than *f*3.5

Photo, Harold B. Abbott

Assuming that the normal lens has a focal length of 1 inch, a 2-inch lens will give a relative magnification of " two times."

The greater the relative magnification of the long focus (or telephoto) lens the more care must be exercised in keeping the camera perfectly steady, and it may be taken as an axiom that a tripod is indispensable for any greater magnification than " 2×," while even for the latter a tripod is advisable. If only one long focus lens is to be acquired in addition to the normal lens, a " 2× " relative magnification is of greater all-round utility than the higher magnifications.

General Hints. When the sun is shining every effort should be made to avoid the " flat lighting " which results from having the sun directly behind the camera. The usual recommendation is to have the sun slightly to one side (" three-quarter front " lighting) ; but a direct side lighting may be quite effective when sufficient light is reflected into the shadows. For cine portraits and close subjects a white sheet or similar reflector may be used to lighten the shadows.

Excellent effects are possible by " shooting " with the sun *in front* of the camera (back lighting [*q.v.*] or *contre jour* lighting), but care must be taken that the sun's rays do not actually strike the surface of the lens. A lens hood is almost indispensable when using the camera in this way, although if the camera itself is in shadow it may be possible to manage without a hood.

Portraits and similar subjects taken *contre jour* must be assisted on the shadow side by means of a reflector.

The obvious viewpoint is not always the best. Frequently a subject is improved by adopting an unorthodox viewpoint (*see* Angle Shots), and the advanced worker makes full use of original angles (*see* Amateur Cinematography: [3], pages 327–337).

Something has already been said of fixed-focus and focussing cameras and the fact

that the latter may be adjusted to give sharp images of subjects at any distance between 2 feet and infinity. This implies that the focussing camera must be "focussed" for every different subject; but inasmuch as the fixed-focus camera is merely one in which the lens has been permanently focussed for a particular distance, it is obvious that a focussing camera may be used as a fixed focus camera merely by adjusting the lens for a particular distance and ensuring that no larger aperture than *f*3.5 be used (larger apertures may be used, but the range of sharp focus will be reduced thereby).

At every setting of the lens there is a margin in front of, and behind, the distance actually focussed upon, wherein objects will be sharply defined: this is known as the Depth of Field, or Depth of Focus (*q.v.*). The depth of focus is reduced as the aperture (or *f* number) is made larger; but as the aperture is reduced so the need for exact focussing becomes less. By focussing the lens for a distance between 15 and 20 feet a focussing camera may be used in the same way as a fixed focus camera for subjects between about 10 feet and infinity, so long as the aperture is not greater than *f*3.5.

CINEMATOGRAPHY, AMATEUR: (3) ADVANCED METHODS

Gordon S. Malthouse

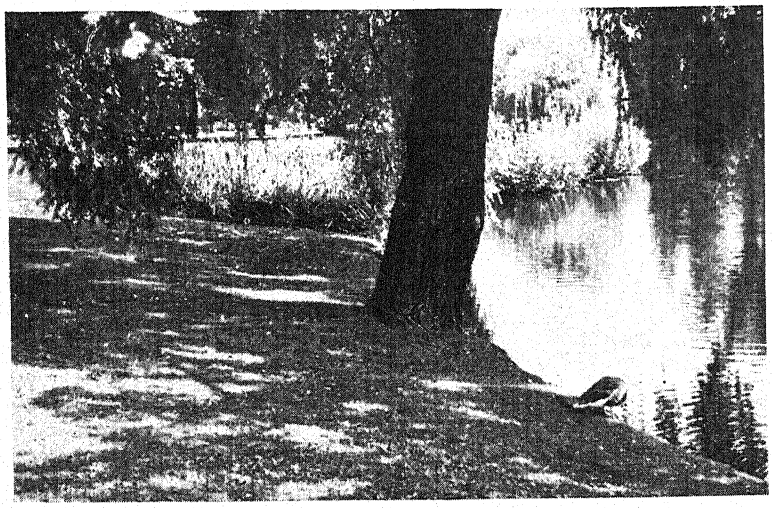
Editor of 'Amateur Cine World'

In the pages preceding this section the basic principles and elementary practice of amateur cinematography have been simply discussed so that the beginner may understand clearly the lines upon which to work. Here he is carried a stage further in the art, and is shown how to obtain rhythm by balancing the length of shots. Other matters related to the production of a film are also dealt with in this authoritative article

See further under Continuity; Editing; Scenario

THE amateur has already been told (*see* preceding Hints for Beginners) how to break up a scene or action into its several parts and make a sequence out of them. We have now to consider how the length of the individual shots of a sequence affects the result on the screen. As an example: A man is dozing by the bank of a river on a peaceful summer afternoon when he is suddenly startled by a cry for help, and seeing a bather in difficulties, dashes to the rescue. This incident might be shot as below.

1. L.S. Sky with majestically banked clouds, framed by foliage in foreground.
Tilt down to
2. L.S. An embracing view of the river.
Cut to
3. M.S A corner of a quiet backwater.
Cut to
4. M.S. The backwater, looking towards a bank clothed in lush grasses. A hand suddenly appears out of them and throws a cigarette end into the water.
Cut to
5. M.C.U. The cigarette end falling into the water. A duck paddles over to it expectantly. A pebble is thrown into the water, at which the duck scurries off indignantly.
Cut to
6. M.C.U. Man, only head and shoulders visible, leaning on one elbow and idly throwing more pebbles.
Cut to
7. C.U. The man, bored contentment written on his face.
Cut to
8. C.U. Picturesque spot by the river, grasses gently quivering, water rippling.
Cut to
9. L.S. The summer sky seen through a leafy branch.
Cut to
10. C.U. Man looking up happily. He shades his eyes, yawns and begins to—
Cut on action
11. M.C.U. —roll over on to his back. A few spasmodic movements and he settles himself comfortably.
Cut to
12. C.U. His eyes open and close until drowsiness finally overcomes him.
Cut to
13. M.C.U. A stagnant corner of the river.
Cut to
14. M.S. A view of the river and banks.
Cut to
15. M.S. Shot from a few feet above the ground (from a convenient tree, say) of sleeper.
Cut to
16. C.U. (From same angle) of his face, his mouth open vacantly.
Cut to
17. M.C.U. The duck, which had been driven off, returns and seeks idly for food.
Cut to
18. M.S. Part of the bank, showing short shadows of the trees.
Fade out
19. M.S. Fade into the same shot as 18, but the trees cast longer shadows, indicating that the afternoon is drawing on.
Cut to
20. M.C.U. The sleeper.
Cut to
21. C.U. His chest gently rises and falls.
Cut to
22. C.U. A mighty splash right up at the camera



SEQUENCE AND SUGGESTION. Here is an example of how an incident in a film is built up with the right tempo and atmosphere by varying the length of the different shots and arranging them in relevant sequence. First (left), a medium shot is taken of a quiet riverside scene suggesting peacefulness and solitude. The shot is long in order to unfold the plot in a leisurely manner, as indicated in the text sequence (page 327)



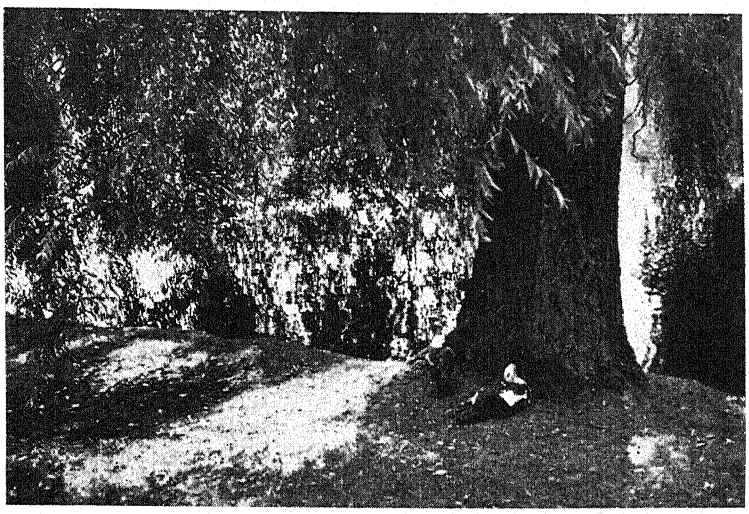
After cutting to other introductory shots, a medium close-up is introduced of a man lying in the sun on the river bank. His actions and facial expression suggest contentment and repose, and the atmosphere of tranquillity is continued by cutting to other shots of the man's surroundings

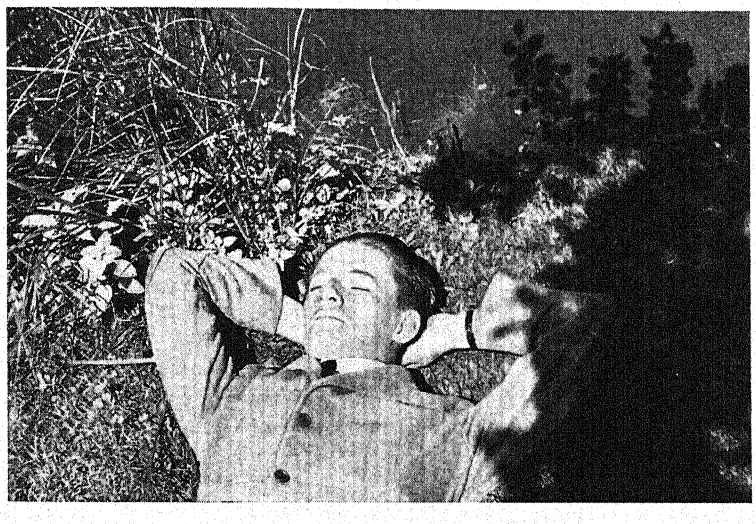


Then a close shot (No. 23 in the sequence) of a hand appearing over the river bank effectively introduces the fast-moving sequence indicating a bather in difficulties. Here there is a violent change of tempo, the shot being short and in strong contrast to the preceding scenes

Photos, Gordon S. Malthouse

THE STORY CONTINUES. A shot showing the shady bank makes an additional contrast with the close-up of the bather in difficulties. It carries along the element of excitement and builds up the suspense. The photographs in these two pages are stills of six shots out of the 54 listed in pages 327 and 330.

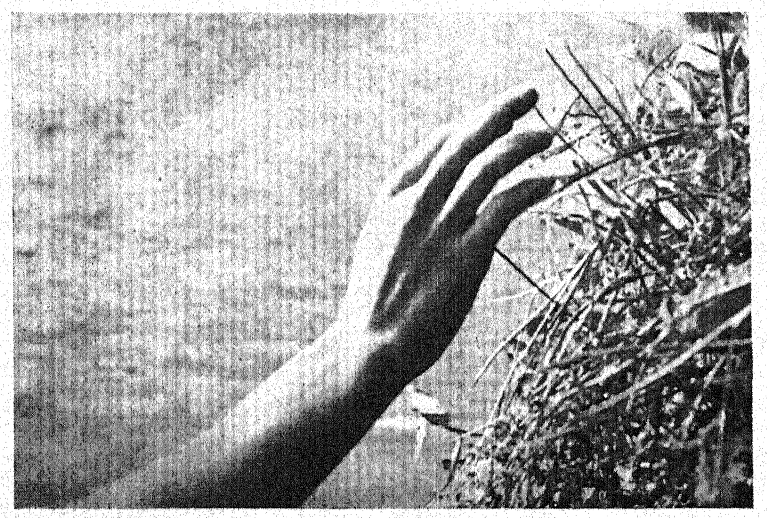




The suspense is accentuated by cutting to the man on the bank, who is seen in a close-up with eyes closed. He stirs uneasily but does not awake, oblivious of the bather's plight. This is shot 25 in the sequence (page 330)

From the above shot a cut is made to a close-up of the bather's legs thrashing the water, and the close-up, shown on the right, follows to show again the hand reaching vainly for support at the bank. The story continues in the sleeper waking, frantically throwing off clothes and shoes, diving in and rescuing him. The last shots are of the two lying exhausted on the bank (see text page 330)

Photos, Gordon S. Malthouse



Cut to

23. C.U. Hand frantically clutching at slippery bank.

Cut to

24. C.U. Legs thrashing water.

Cut to

25. C.U. Sleeper stirs uneasily but does not awake.

Cut to

26. C.U. Shot 24 continued.

Cut to

27. C.U. Shot 23 continued.

Cut to

28. C.U. Bather calling for help.

Cut to

29. C.U. Sleeper (A) awaking with a start. He looks out of picture to—

Cut—

30. M.S. —bather (B) struggling in river.

Cut to

31. C.U. A darts up and before he leaves frame

Cut on action to

32. M.C.U. —him struggling to his feet.

Cut to

33. C.U. Similar shot to 28.

Cut to

34. M.S. A running towards B. He starts to peel off his coat as he runs.

Cut to

35. C.U. Coat thrown full at camera. As it falls, A is seen a few yards away, speeding along.

Cut to

36. C.U. Similar shot to 24.

Cut to

37. C.U. A's legs running by camera.

Cut to

38. M.S. B in water.

Cut to

39. M.C.U. B in water, looking appealingly in A's direction.

Cut to

40. M.S. A gets to river bank, kicks off shoes. One will not come off easily.

Cut to

41. M.C.U. A struggling frantically with shoe.

Cut to

42. C.U. Similar shot to 28.
43. M.C.U. Shot 41 continued.
44. C.U. Shot 42 continued.
45. M.C.U. Shoe is off. A dives in and swims towards B, who is seen in distance.

Cut to

46. M.S. A, as seen by B, who is in foreground.

Cut to

47. M.C.U. B, still in difficulties. A not in picture.

Cut to

48. M.C.U. A swimming towards B.

Cut to

49. M.S. A reaches B.
50. C.U. He grasps him. There is a struggle, but—

Cut to

51. M.C.U. —A pulls him steadily—

Cut—

52. M.S. —towards bank—

Cut—

53. M.C.U. —on to which he hauls him and—

Cut—

54. M.C.U. —both lie down exhausted.

Just as each shot must have some affinity to the next in subject matter, so must it have a relationship in length. The tempo, or rhythm, of a film is decided by the length of the shots, which in its turn is determined by their subject. Shots 1–21 are of a peaceful nature and should, therefore, be long in length. The plot is unfolded in a leisurely manner; if the introductory shots are quick, then the film will begin too briskly, and this would be alien to the theme.

Even so, while shots 1–21 are comparatively long, they must not all be of the same length; if they were there would be no rhythm, and it is the rhythm of a film which emotionally effects an audience. Long shots such as 1 and 2 will be longer in length than 3 and 4, while 2 will be longer than 1. In 1 there is practically no movement and the eye soon tires of looking at a static shot, but there would be a little more movement in 2.

In a scenic film largely composed of long shots an endeavour should be made to secure some movement, be it only the waving of a branch, the rippling of a pool, a newspaper blown along the road by a breeze, or a man in the distance wending his way over a hill. The eye automatically focusses on the movement, and the interest is therefore conserved. If there is nothing of the kind the shot outstays its welcome.

Keep Shots Short

If movement cannot be secured, then a long shot should not be held on as long as a precisely similar shot in which there was this movement. Just how long the shot should be only the individual can judge, but it is a common fault of the beginner to make all shots too long. One and a half feet is about right for an establishing long shot, one foot for close-ups of people, and ¾ foot for close-ups of inanimate objects, but these figures can only be approximate, as so much depends on the nature of the shot and its context.

Shots 3 and 4 are slightly shorter than 1 and 2 because the field embraced by the frame area is smaller and consequently there is less for the eye to take in. But here, again, there is more movement in shot 4 than in shot 3, so that the former can be slightly longer.

In the fountain sequence analysed in the preceding article the shots are all obviously related, but this is not apparently so in the

case of shots 7–10 in the scenario above. Closer study will, however, show that each shot has an affinity to the next. Shots 8 and 9 help to express the man's mood; they are an integral part of the scene. But the audience does not necessarily expect to see them, while after a medium shot of a person drinking at a fountain they would be quite prepared for a closer shot of the drinker. Such " atmosphere " shots must therefore be introduced carefully. They must not be abruptly cut in so that the audience is surprised or—worse—disturbed.

Atmosphere and Scenic Shots

It will be appreciated that the " atmosphere " shots are essential, because if the man alone were featured it would be difficult to convey a clear idea of the peacefulness of the scene, and it is necessary to do this in order to provide a striking contrast with the violent movement that comes later. Shot 10 is linked to shot 9 by the action of the man. Had he been lying looking at the river, the juxtaposition would still have been quite happy, but his looking up suggests that he has been looking at the previous scene.

When it is desired to show scenic long shots it is often advisable to introduce them by a shot of a person presumably looking at them, or of some object connected with them; *e.g.* after some shots of people playing on the beach it is desired to show shots of the cliffs. The latter have no real relationship with the beach game, but they can be linked to it by a medium close-up or close-up of one of the holiday-makers suddenly looking up, and then cutting to the cliffs, the inference being that the person is looking at them, though he might quite well have been looking at something else. This point is amplified in Continuity (*q.v.*).

Shot 15 illustrates the man's relation to his surroundings. He is part of them and as it were, absorbed by them. The angle has the effect of dwarfing him and subduing him to the background. Were the shot taken from a low viewpoint he would dominate the scene, and this would be contrary to the desired impression.

Up to shot 21 the film proceeds in a leisurely manner. With shot 22 comes a sudden violent change of tempo. While shot 21 might be some one or two feet in length, the footage of shots 22–24 might be only some 6–9 inches. If these three shots were of the same length as the preceding ones they would be lacking in excitement. It is the sudden quickening of tempo and violent contrast that stir the audience.

The succeeding shots are all very much shorter than the " lazy afternoon " ones, but even so there is a definite relationship of short to longer shot. This is parallel action, *i.e.* the showing of two different sets of action which take place simultaneously. Quite obviously we cannot show the two sets simultaneously on the screen. In making films we compress real time into filmic time (*e.g.* shots 1–21 take much shorter to show on the screen than occurs in actuality. An afternoon is compressed into a few minutes).

In the case of parallel action we must expand real time into filmic time. This is done by quickly intercutting shots from each set of action. They must be quickly cut, otherwise the audience will be conscious of the false presentation of time. Nevertheless, one set of shots must be cut quicker than the other in order to heighten the excitement. A familiar example is in the sequence seen in professional films in which the heroine is slowly being overcome by the villain, while the hero races to the rescue. The shots of the ride to the rescue are quickly cut to maintain the excitement, while those featuring the heroine are slower to heighten the suspense. In our scenario the unfortunate bather takes a longer time in going under than might be the case in actual fact.

Close Shots for Dynamic Action

It will be noted that shots 22–29 are all close ones. This is because close shots in which violent action occurs have a dynamic effect. The salient feature of the action is, as it were, thrust at the audience. Most of the shots from 22 to the end are close ones for the same reason, but an occasional medium shot is introduced so that the audience does not forget the surroundings and is able to appreciate the distance A has to go. If the shots were all close it would be impossible to define the location and the audience would be unable to gauge just how the race to the rescue was proceeding and whether A would be in time.



MOVIKON. Made by Zeiss Ikon, this 16-mm. cine camera has a range-finder coupled to the lens, an automatic parallax adjustment to the view-finder and adjustable shutter speeds. The instrument carries 100 feet of film

From shots 31–39 the shots featuring A are a little shorter than those of B, but now we suddenly alter the tempo, so that the audience is made to feel the dismay of B at the delay in the kicking off of the shoes. Shots 40, 41 and 43 will therefore be longer than 42 and 44. While A is held up, B is drowning.

Shot 54 is not the real conclusion of the film of this little episode ; it is too abrupt. There should be a few shots of comparatively long footage to slow up the action and round off the film.

Importance of Continuity

This cameo lends itself to expressive cutting and balancing of short shots with long ones, and the same principle holds true with all types of film. But since it depicts continuous action it does not offer quite the same problems in continuity as would, say, a holiday film, in which are compressed on a reel of 400 feet the varied events of a fortnight. In professional film production a continuity girl is employed to see that there are no discrepancies or lapses in related shots; she must make sure, for instance, that the hero does not enter a room wearing a striped tie and leave it with a spotted one. Hers is a very necessary work because film production is of a spasmodic, fragmentary nature: the closing scenes of a film might very well have been shot at the beginning, because all scenes that occur in one particular location are, for convenience and economy, shot together, regardless of their place in the picture.

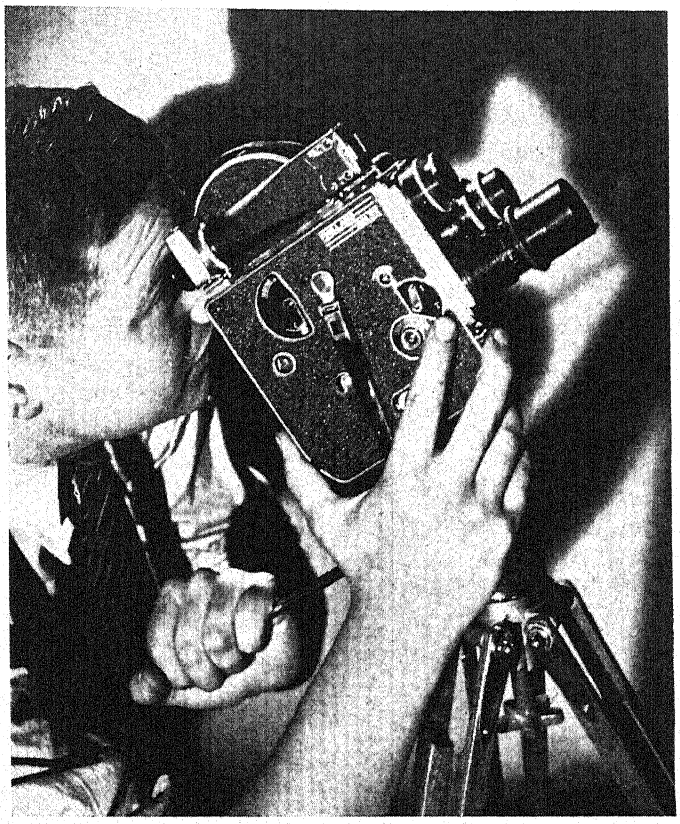
Amateur film production is, of course, far less complicated than professional film-making and usually the amateur does the whole job himself, so that he does not need to exercise such meticulous care over continuity. But however unpretentious a film, it must have this quality—a series of images which flow easily and logically, each shot being in some way related to the next and thus advancing the action.

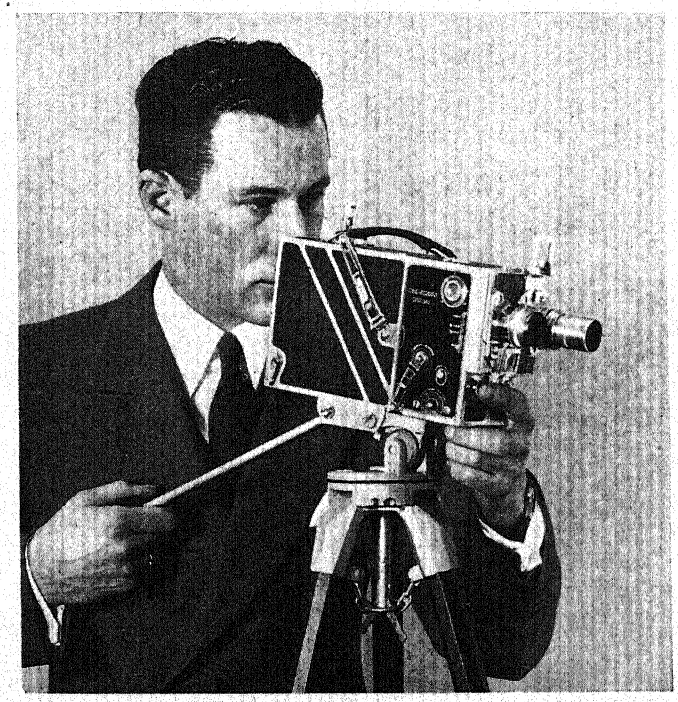
Although it is not always easy to achieve this in a film covering a lengthy period of time, a great deal can be done in the editing or cutting stage. Associative cutting is largely employed to link dissimilar sequences; *e.g.* in making a holiday film it is desired to link up shots of the family in a launch, harbour scenes and baby playing with a toy boat, all taken on different days. It would be a natural transition from the launch to the harbour and its environs, for the subject matter of the shots has a certain affinity. After a shot of a boat in a harbour a cut could be made to a shot of another boat. A hand comes down and takes it up, revealing that it is a toy boat, this shot introducing the " baby " sequence. We have thus achieved a natural flow by matching the shots.

If a scenario (*q.v.*) is prepared in advance the construction of the film becomes a relatively simple matter, but it is rarely

possible to prepare a script for a holiday film to cover a place with which the cameraman is unfamiliar and to plan for events that might never occur. The amateur must, therefore, cultivate a visual memory, carrying in his mind's eye the shots already taken and choosing subsequent material only if it will link up with them in some way.

Even though the subject of a film is such that a scenario can be compiled, it would be a mistake to sit down right away to write it. The plot or theme should first be written as concisely as possible, and then expanded into a " treatment " or full synopsis, and it is from this that the scenario is constructed. Script writers for professional films make an " adaption " before the " treatment." The advantage of thus working step by step is that one is in a better position to excise all extraneous matter and to decide at the outset what is cinematic material and what is not.

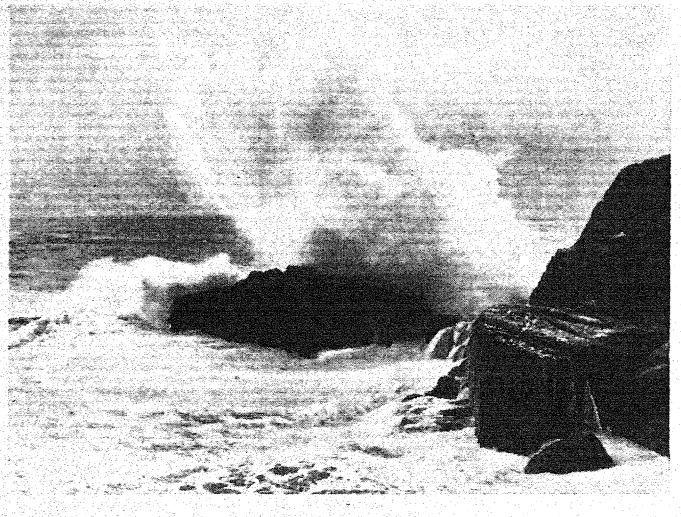


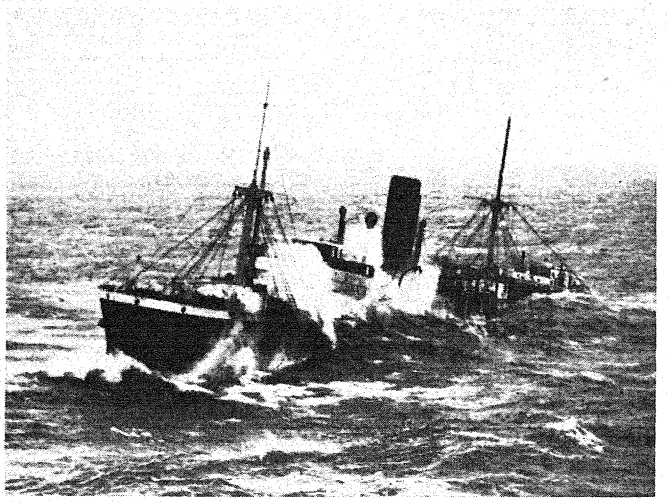


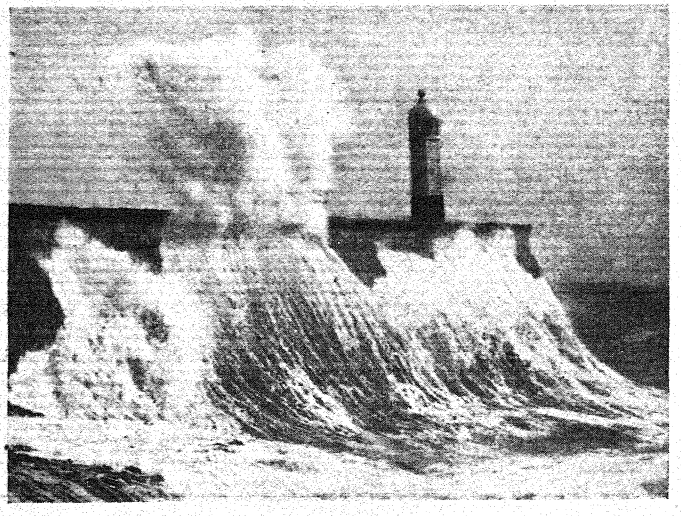
FOR ADVANCED WORK. This is the Paillard-Bolex H16 16-mm. camera. Note the three lenses and parallax compensated view-finder. Below, Cine-Kodak Special taking 16-mm. film. It is available with either a spring or electric motor drive and seven interchangeable lenses. Both cameras are designed for the skilled amateur

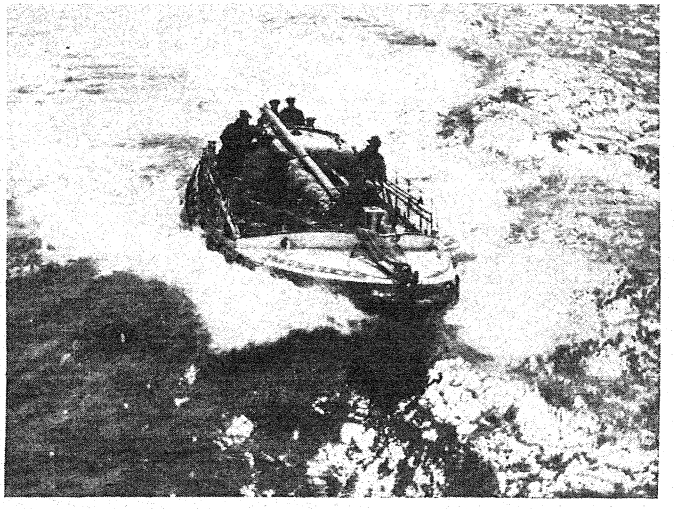
Upper photo, courtesy of City Sale and Exchange (1929), Ltd., Fleet Street

If his theme cannot readily be translated into a series of action pictures, then the amateur would be well advised to discard it. States of mind, for instance, do not readily lend themselves to pictorial expression. At the same time, it will frequently be necessary to use words (or sub-titles), but they should never be used if pictures are self-explanatory; *e.g.* " Seagulls on









ASSOCIATIVE CUTTING. Individual shots taken without preconceived plan can sometimes be amalgamated to form a definite theme. Shots of the four scenes shown in these stills, for example, could tell a story of the sea, when cut and joined up in logical sequence. The reel might start with the shot of the waves breaking over the rocks and then would cut to the steamer in distress. The lighthouse shot would follow and the lifeboat setting out would form the finale

Photos, Fox

the jetty " would be a bad sub-title because the audience could very well see for themselves that there were indeed seagulls on the jetty. The amateur should, therefore, word the sub-title in such a way that he either gives information about the gulls not readily apparent from the pictures or prepares the audience for a shot of them without baldly saying they are about to be seen.

In the first case he might write : " The kittiwake gulls have no hind toes, but that does not seem to bother them "(in which case the shot of the birds should be a close one) ; in the second : " The handsome scavengers of St. Ives " (*see* Titling).

All of these methods of film construction call for some creative ability, but the amateur can also utilize the purely mechanical function of his camera to assist the action. Chief of these are Stop Motion (*see* Animation *and* Cartoons), Slow Motion, Half Speed and Reverse Motion.



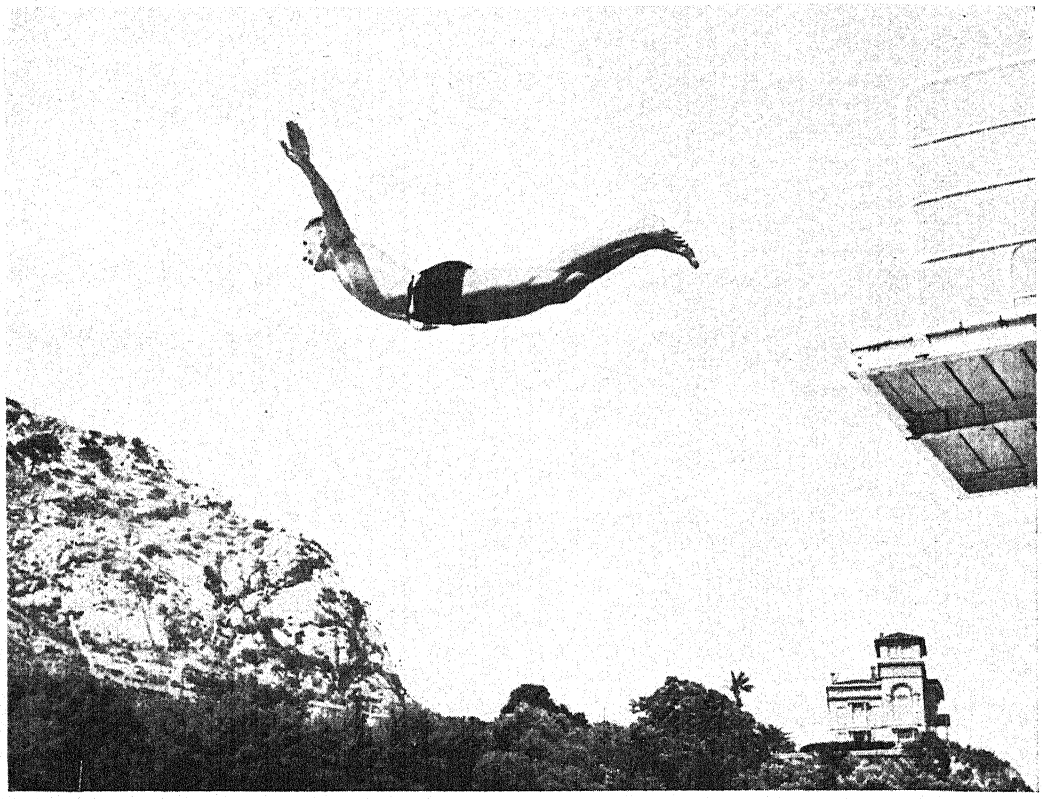
ENSIGN SUPER-KINECAM. A 16-mm. camera taking 50 feet to 100 feet of film. Special features are the turret for taking three interchangeable lenses and the " tri-optic " view-finder. Both hand drive and motor are incorporated

Uses of Slow Motion

Slow motion with the sub-standard cine camera is at the rate of 64 frames a second, which is very much faster than the slow motion seen on the professional screen, and its uses are therefore circumscribed within somewhat narrow limits. Its obvious uses are to analyse action in athletics, to show the grace and beauty of a dive, and so on. The beginner invariably uses it simply as a trick which he ingenuously parades, quite irrespective of whether the retarded motion has any logical connexion with the development of his film. It is not often that speeds faster than the normal 16 f.p.s. can be used as an integral part of the action, but instances will occur to the reader in which it is an advantage to slow down the action : to concentrate attention on some operation, for instance, or to smooth out camera jerk in shots taken from moving vehicles.

Half speed has wider applications. It requires half the normal exposure, and it is, therefore, possible to film under conditions in which there was insufficient light for filming at 16 f.p.s. Any action, however, is speeded up to an exaggerated degree, so that unless such action is definitely required, there should be little or no movement in scenes filmed at the faster rate or movements should be made deliberately slow, wherever possible.

The chase that invariably ended early professional films (the mad ride of the Keystone Cops, pursuit of the villain by the sheriff's posse, etc.) was filmed at faster-than-normal speed, which is still used extensively today, *e.g.* in the gangster's breath-taking drive through crowded city streets. Exaggerated slowing up or down of movement has many amusing possibilities for the amateur with a sense of humour ; *e.g.* a stream of city workers wending their way to the office could be filmed in slow motion, and their return in the evening filmed at half speed.



SUBJECT FOR FILM FAKING. The high diver in action, seen above, would make a good subject for trick photography with a cine camera. By the simple expedient of taking the shot with the camera held upside down the dive could be reproduced in fantastic reversal. Running the camera at quadruple speed would produce a semi-slow-motion effect. But care should be taken to ensure that this kind of trick work is not overdone or it will become tedious instead of amusing

Photo, Topical

As far as reverse motion is concerned the novice's inventive capacity rarely rises higher than showing bathers diving out of the water back on to the diving-board or people regurgitating bananas. To show reverse action, the scene is filmed with the camera held upside down. When the resultant film strip is processed and spliced in the film the right way up the action is reversed on the screen. Reverse motion is used imaginatively when the fact that the motion is indeed reversed is not obvious; *e.g.* a man dashes up to a six-foot wall and vaults lightly over it. With the camera upside down he is filmed on top of the wall, down which he proceeds to clamber backwards. When the film strip is inserted the right way the effect is that of the man vaulting easily to the top. It could be still further enhanced by filming the run up at a faster than normal speed.

Reverse motion is often employed for titles; *e.g.* letters appear from all corners of the screen and neatly slide into place. The title, in correct order and alinement, is filmed in reverse and the letters are then blown away.

Variable speeds, in common with all other mechanical devices such as Wipes, Dissolves, and Fades (*qq.v.*) should be used with discretion and properly harnessed to the job in hand, for the camera is the movie-maker's servant, not his master.

Lenses. The 20-mm. and 1-inch lenses which are normally fitted to 9.5-mm. and 16-mm. cameras are quite sufficient for all ordinary needs, but the amateur who has interchangeable lenses has at his command a valuable aid to cine technique. The telephoto lens is perhaps the most useful; it brings distant subjects close, and its many uses will at once be apparent. The wide-angle lens, conversely, covers a greater width and suggests spaciousness, so

that it is particularly useful for filming in a limited space, *e.g.* in a small studio in which it is difficult to get far enough away from the subject to produce a suggestion of spaciousness.

A telephoto lens entails the use of a tripod to ensure that the shots are absolutely steady. A camera fitted with this lens must not be held in the hand. Some cinematographers urge that a tripod should be used for every shot, no matter with what lens it was taken. This is a counsel of perfection, and many workers are unwilling to forgo the freedom and ease of manipulation that holding the camera in the hand gives them.

CINEMATOGRAPHY, AMATEUR: (4) FILM PROCESSING

The different methods employed in preparing sub-standard, positive or reversal films for projection are here outlined. The subject is dealt with fully under the heading Processing

Processing refers to all the operations on a film after it leaves the cine camera, to render it suitable for projection in a complete form upon a screen. There are two main divisions — the negative - positive and the reversal method.

The negative-positive, usually abbreviated neg.-pos., is similar to the methods used for the preparation of an ordinary shapshot, with the exception that the finished print is on a transparent celluloid base instead of on paper. The transparency so produced is similar to a lantern slide, but is printed upon a flexible support instead of on a rigid one.

The Reversal Method

The reversal method, though perhaps a little more complex in the laboratory treatment, was introduced to cheapen amateur cine work, since in this method the original film which went through the cine camera is used for projection. Although the film does pass through a negative stage, it is " reversed " and made to form a positive image. In this way only one film is used, whereas with the neg.-pos. system two films are required—one for the negative and one for the print which is made from the negative. Each system has its own advantages and disadvantages. In the case of the neg.-pos. system copies are cheaper, as the processing is perhaps a little simpler ; whereas in the reversal system the copy made from the reversal original must also be " reversed " to give another positive print. With careful modern processing, however, it is possible to make a duplicate negative from a reversal print and run off from this new " dupe " negative as many prints as are required.

One considerable advantage which was claimed originally for the reversal process was that of fineness of grain and perfection of quality. It is an inherent factor in reversal methods that the grain should be finer than in neg.-pos. methods. It is the larger grains which are most affected by the light making the original exposure in the camera, and these grains are most vigorously developed in the first developer and are then eaten away in the reversing bath; therefore the grains which are left, and which form the positive image, must of necessity be the smaller ones in the emulsion. However, with modern emulsions in the neg.-pos. process and greater care in the laboratory, this claim for finer grain is no longer of such great importance.

Producing Special Effects

To the serious amateur, though, the neg.-pos. system holds the greater attraction, since with an original negative and a little ingenuity as regards printing equipment he can produce many of the effects which are seen in the ordinary cinema. Many of these effects are denied to the worker with reversal film, unless the effects are photographed in the camera. This method has many limitations, as it is not possible to alter easily the position of fades, dissolves and other transition effects in the cutting and editing if they do not fall into the general scheme or plan of the finished film.

Most of the popular colour systems also work on the reversal process. Some obtain their control over the colour by direct means, while others rely upon the amount of silver deposit at one stage or another in the film processing to control the formation of dye images, the silver deposit afterwards being removed entirely. In one process it is stated that the amateur may be able to do his own colour processing, owing to the simplicity of the system.—*STANLEY W. BOWLER, A.R.P.S.*

CINEMATOGRAPHY, AMATEUR: (5) COLOUR FILMS

G. B. Harrison, Ph.D., F.R.P.S.
Of Ilford, Ltd.

Photographic reproduction in natural colour has engaged the attention of research workers for many years, and one of the most recent advances in its development is in projection by sub-standard cinematography. In this article the subject is fully discussed from the point of view of the amateur cine user. For the theory of the subject and the processes employed, *see further under* Colour Photography

Standard Cine Colour Photography (35-mm). All early processes exhibited in the cinemas were based on the two-colour method (*see* section on Colour Photography) because it was relatively easy to produce two differently coloured images, one on either side of the film. The colours produced on natural outdoor and studio subjects were somewhat crude, the typical appearance being a predominance of red and an absence of pure greens or blues, giving the effect of viewing the scene through amber-coloured glasses. Flesh tones were reproduced as if sun-tanned. The addition of the third colour presented extreme difficulties, as it made it necessary to place at least two of the three images on one side of the film. Three-colour processes have now been achieved, and film made by means of them can be seen in the cinemas. Processes employing both the additive and subtractive systems have been shown. " Becky Sharp," " The Trail of the Lonesome Pine," " Garden of Allah " were the early pictures made in three-colour Technicolor (subtractive), and a series of news-reel films commencing with the Coronation of King George VI by the Dufaycolor process (additive).

Other types of three-colour processes which are worthy of mention in the standard cine field are the lenticular type, and the triple projection type employing a beam-splitter camera producing three images simultaneously in juxtaposition on the cine film, and re-combining these three images projected through three suitable filters by means of a special device fitted in place of the lens in the projector.

The chief merit of the three-colour processes is in colour rendering. Saturated reds, greens and blues can be recorded, and the pictures have lost the overall reddish appearance prevailing in the earlier two-colour systems. The two-colour system, however, is still popular, particularly for cartoons, in which it is possible to choose the colours to suit the process without seriously affecting the artistic effects sought. Most colour cartoon films are made in two-colour, with the notable exception of the Walt Disney " Silly Symphonies " and coloured " Mickey Mouse " films, which make use of the three-colour Technicolor process.

All colour processes have certain limitations in production. The film must necessarily be appreciably slower than black-and-white, so that it is necessary to employ more light in the studio. Except when producing special effects, it is necessary to use one type of lighting only, *e.g.* daylight, arc light or incandescent (half-watt) light; two types of light cannot be mixed on one set (except for special effects), as is so common in black-and-white work. Incandescent (half-watt) light, which has become so popular for black-and-white cine work, is not very satisfactory for colour owing to its low blue light content, and arc light is almost universally advocated for studio lighting.

Sub-Standard Cine Colour Photography. One of the greatest difficulties that has stood in the way of successful three-colour standard colour cinematography has been the necessity of producing a number of copies for circulation to the cinemas. Very beautiful results have been obtainable for years by means of mosaic processes, such as Dufaycolor and lenticular processes, by reversing the camera exposure to produce a positive, but it is only recently that it has been possible to produce satisfactory copies. Sub-standard colour photography clearly does not suffer from this limitation, because the amateur usually requires only one copy, though a system capable of good duplication would be an advantage for sub-standard clubs, educational, and advertising purposes.

There are, therefore, more processes available to the amateur than in the standard field. Representing the additive class are the mosaic and lenticular processes, while Kodachrome may be taken as a typical example of the subtractive class.

The Technicolor process is unsuitable for amateur work because of the cost of the special camera necessary to obtain the separation negatives, and the fact that the process is designed to produce large numbers of prints at an economical cost. In fact, it can be likened to the printing business, in which the cost of one copy is nearly as great as that of a hundred.

Types of Process. It is not possible to say which is the more satisfactory, the additive or subtractive type of process. The amateur should experiment with all available processes and choose that which appeals to him most. All sub-standard colour films are made on what is termed "non-inflammable" or "safety" base. In general, the additive method has the advantage that good reproduction of colour is possible, because the additive colours required by theory can be closely approximated in practice and employed in manufacturing the mosaic, or used in conjunction with the lenticular film.





SUNLIGHT AND COLOUR. In colour photography carried out in sunlight the best results are obtained with the subject placed so that heavy shadows are avoided, as seen in the picture above. The diaphragm opening should be between *f*8 and *f*11. Where it is necessary to photograph with side lighting, however, the setting should be between *f*5.6 and *f*8. Below, an example of side lighting

Photos, Courtesy Kodak, Ltd.

The chief disadvantage lies in the fact that the white light from the projector is split into three sections—red, green and blue—by means of filters, each of which absorbs at least two-thirds of the light, with the result that the screen brightness is reduced to one-third in theory and usually to about one-fifth or less in practice. At the same time, in this type of process the mosaic pattern is visible on the screen, causing an apparent slight loss in sharpness. The

subtractive method is not at present able to yield such faithful reproduction of colour because of the difficulty of producing colours in the images approaching those dictated by theoretical considerations. This method, however, makes full use of the light available in the projector, is capable of very high definition and shows no pattern on the screen.

Speed. All colour films, both additive and subtractive, must necessarily be slower and require more exposure than the fastest black and white films available. This is because all colour films rely on normal black and white emulsions for their speed and all suffer a reduction in the amount of light reaching the emulsion by the filtering system employed in dividing the incident light from the subject into three parts. Their speed is therefore less than one-third that of the equivalent monochrome emulsion which can make use of all the light incident.

Range of Exposure Permissible. All amateur colour films are developed by the direct chemical reversal process, instead of first making a negative and finally a print, as is possible in monochrome work, both on account of the difficulty and the cost of making prints from colour films. The reversal process is also popular in monochrome sub-standard cinematography, though both types of process are available. The additive processes in general can, if desired, be processed by the amateur. Reversal processing is not a difficult operation to perform, but owing to the awkward length of film to be handled the amateur is not advised to process his own colour films without adequate equipment. He cannot process films of the Kodachrome type.

In monochrome reversal processes it is possible to give a range of exposures on a given subject varying by a factor of as much as 16 to 1, *e.g.* *f*4 to *f*16, and in the processing compensation can be introduced to produce almost identical results whatever exposure is given between these limits. The control is analogous to the variation in printing exposure that would have been made had the original exposure been developed to a negative and a print made from it. Colour films do not possess this latitude in exposure, and it is necessary to estimate the correct exposure much more accurately if satisfactory results are to be obtained. A variation in exposure over a range of 2 to 1, *e.g.* *f*4 to *f*5.6, is permissible, and a range of 4 to 1, *e.g.* *f*4 to *f*8, may be just tolerable, but accurate exposure well repays the trouble taken.

The characteristic effect of under-exposure in colour films is that the whole picture is very dark (particularly in additive processes), there is an absence of shadow detail, and the paler shades are inclined to become too highly coloured, *e.g.* flesh colour may appear reddish or deep brown according to its original tendency. Over-exposure is characterized by a very light picture with an absence of detail in the high-lights; all colour in brightly illuminated pale shades may disappear and more saturated colours will tend to become paler. The range of tones that can be reproduced correctly by colour processes is in general smaller than in monochrome work, and it is therefore inadvisable to attempt very contrasty or high key subjects until the possibilities of the particular process used have been explored, and, as in monochrome cinematography, the greater the subject range the more accurate must be the exposure if the best possible result is to be obtained.

Exposure Factors for Colour. It is almost essential to use an exposure meter or calculator for colour work because of the importance of accurate exposure, and probably the most suitable type is the photoelectric exposure meter; any reputable make will be found satisfactory. In producing a good monochrome negative it is customary to " expose for the shadows and let the high-lights take care of themselves," because modern negative materials are capable of reproducing any range of tones normally met with in practice, and if the shadows are given just sufficient exposure to render detail adequately, the minimum but sufficient exposure will have been given.

A long range contrasty subject (*e.g.* white cottage with adjacent heavy shadows under trees) will, if this rule is obeyed, have its high-lights reproduced as high densities and a relatively long printing exposure will be required; conversely, if the high-lights of a flat low key subject (*e.g.* distant landscape) have the same brightness as those in the cottage scene, the shadows being less heavy, less exposure will be required, and the

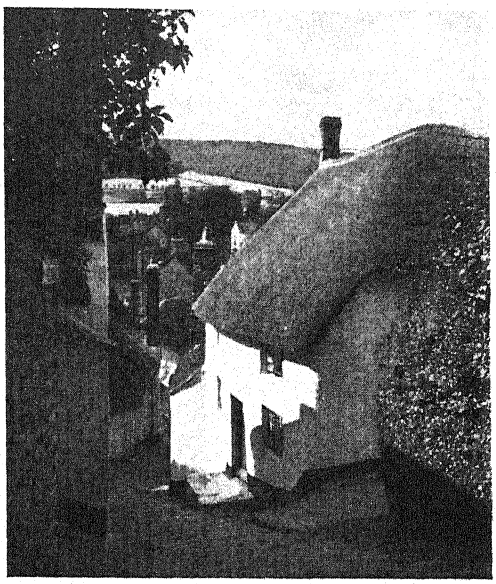
high-lights will be reproduced by a relatively low density and the negative will require only a short printing exposure. This difference in type of subject is often taken into account in exposure meters, less exposure being given to " landscapes " than to subjects with " heavy foreground."

In reversal colour processes there is, of course, no adequate adjustment which is equivalent to the printing exposure above, so that the shadows would always be reproduced by the same densities whether heavy or light in the original scene, and we can therefore no longer afford to " expose for the shadows and let the high-lights take care of themselves." If we did so we should find, in the case of the landscape, that the shadows were too dark and the high-lights and sky very little lighter, the whole picture looking very heavy. In the case of the cottage we might get an excellent picture of the objects in the shadows under the trees, but the cottage would be dead white with no texture and the window frames might even have vanished because the latitude of the colour film might be insufficient to record them.

In colour films the high-lights are the most important part and it is necessary to reverse the ordinary rule and " expose for the high-lights and let the shadows take care of themselves." If the brightness of the high-lights in the cottage and the landscape scenes are equal they should receive equal exposures, the range of tones of the landscape will be satisfactorily reproduced, and even if the range of the cottage scene is too great for the material, no increase in exposure will yield a better result. At worst the shadows will be deep black with no detail, and if they do not predominate the rendering will be satisfactory. No allowance should be made on any exposure meter for the type of subject.

Meters. The photo-electric meter is most suited to colour because it is influenced more by brightness of high-lights than shadows in the subject towards which it is directed, and the exposure indicated will therefore be related to the brightness of the high-light. The use of the meter for estimating the exposure for the high-lights has been carried a stage further in at least one make of photo-electric meter (*see* Exposure Meter, Smethurst High Light). It is assumed that every subject contains or might contain a pure white reflecting body, and that this should be reproduced as clear white on the screen. In order to estimate the exposure required to reproduce this clear white correctly, it is only necessary to direct the meter towards a piece of white paper situated in the position of the subject and multiply the exposure obtained by a constant factor found by experiment. In the case of the meter mentioned, a piece of diffusing material is substituted for the window of the meter and is directed towards the light illuminating the subject. The exposure indicated is then correct, because the multiplication factor is incorporated in the calibration of the meter.

Both this type of meter and the more usual type directed towards the subject are suitable for reversal colour cinematography. Visual extinction meters should be used with great care, because they rely to a great extent on the sensitivity of the eye to light at the time of use. For example, when working in brilliant sunlight the eye will be accommodated to a strong light and relatively insensitive, and unless sufficient time is allowed for the eye to accommodate itself to the dim illumination in the interior of the meter, the exposure indicated will be too great. Actinometers relying on the time of



A DIFFICULT SUBJECT. The preponderance of shadow in the foreground and extreme brightness of high-lights on the cottage, seen in this picture, would present a problem in making a shot in cine colour. Here the principle is to " expose for the high-lights and let the shadows take care of themselves "

Photo, Ilford, Ltd.; Selochrome film

darkening of a piece of sensitive paper are not very suitable for reversal colour work because the paper is sensitive to the blue and violet content of the light, whereas the most important constituents of the light from the colour exposure point of view are the red and green. Quite good results can be obtained by the use of ordinary exposure tables which yield the exposure by allocating the factors which govern exposure certain values according to weather conditions, etc., and arriving at the result by calculation or by operating a simple calculator of the disk or slide-rule type. Care must be taken in assessing the value to be given to the lighting conditions prevailing. All subjects should be regarded as " normal " subjects, no allowance being made for " beach scenes," " heavy foreground," etc., but the exposure obtained should be halved when photographing on the beach or if the principal part of the subject is white or very pale colour (such as a figure in a pale-coloured dress), otherwise the delicate colour and tones may be lost through slight over-exposure. Very dark subjects, such as a black dog, should be given twice the exposure indicated by the calculator.

Uses of Filters for Different Light Sources. Colour films are manufactured so that it is not necessary to use any kind of filter in daylight. If it is desired to use the material in any other kind of light a special filter must be placed over the camera lens to convert the light to the colour of daylight before it reaches the film. Daylight is chosen arbitrarily as standard because most sub-standard film is exposed in daylight ; some types of film are obtainable specially " balanced " to be used in incandescent half-watt light without any compensating filter.

Incandescent half-watt light contains very much more red and much more green light relative to blue than does daylight, and if a film intended for daylight use with no filter is used in half-watt light, it will be necessary to cover the camera lens with a blue filter to absorb the excess of red and green light. If this is not done the result will be intolerably orange in overall colour, blues being almost absent or tending to become green. The blue filter used must be accurately calculated and should be obtained from the manufacturers of the particular process concerned. Colour films are in general slow in incandescent half-watt light.

If a certain colour film requires, for example, five times the exposure necessary for a certain panchromatic monochrome film in daylight, it will require more than five times the exposure required by the same panchromatic film in incandescent light when the appropriate filter is used on the lens when exposing the colour film ; in daylight both films could make use of all the light, but in incandescent light the colour film receives less red and green light (removed by the filter) than the panchromatic film which still makes use of all the light available.

The same applies if the colour film is specially made for use in incandescent light without filter, because in this case the red and green sensitivities of the film have been curtailed in manufacture and the effect is almost the same as would be obtained by the use of the filter.

Variation in the " Colour " of Daylight. If we describe as " white " the colour of a piece of white paper illuminated in the open on a summer's day with the sun in a clear blue sky, the light from the sun alone may be described as yellow. If the blue sky is covered with light clouds and the sun still shining, some of the blue light is removed and the light will again be yellow. If the sun then becomes obscured by cloud some yellow light is removed, and the colour becomes more nearly white again. It is clear, therefore, that to obtain identical overall colour balance under all conditions of daylight, it would strictly be necessary to use different filters in the same way as a special filter is necessary in artificial light.

The variations in colour of daylight are, however, relatively small, and up to a point it is desirable to record the differences in colour. The existence of this variation should be remembered before condemning a colour process because two pictures of the same subject are not alike when taken under different daylight conditions. If, for example, a portrait is taken in the shade of a house on a brilliant day when the atmosphere is very clear and the sky deep blue, the shadow is illuminated by the light from the sky alone and lacks the yellow light from the sun ; such a portrait will necessarily have a bluish

tinge which may be unpleasant. A pale yellow filter of the palest "haze cutting" type may be used to correct this, but a trial should be made with the particular filter and colour film before relying on its successful use. For the same reason on such days all shadows occurring in a picture may have a blue tendency that in extreme conditions may be objectionable. These shadows really are blue, but the colour film may tend to exaggerate their blueness.

Reflections from Coloured Objects. In the same way that light reflected from the blue sky may tend to make objects in shadow appear blue, any brightly illuminated large area of colour may impress its colour on an adjacent scene. For example, a blue sea may turn the grey of a man-o'-war into a blue grey, and brown sand may impart a warmth to the clothes and faces of a group sitting on it. It is not often, however, that serious trouble is encountered from such reflections out-of-doors, but in indoor photography by artificial light, if the walls of the room are even lightly coloured they will have a marked influence on the colour balance unless the lights are all enclosed in reflectors so that as little light as possible reaches the walls.

Choice of Subjects and Lighting Conditions. Good subjects for colour films are easier to find than for monochrome because colour very often turns an ordinary scene into an artistic picture. As a general rule pictures in which the principal objects occupy a large section of the screen are more satisfactory than a picture composed of a lot of little bits of colour put together, *i.e.* close-ups are more satisfactory than distant landscapes, though the latter can be very fine indeed if they contain large areas of more or less uniform colour such as the sea and an expanse of sandy seashore.

If you want to photograph flowers, use most of the film in real close-ups after perhaps a short distant shot to give an idea of the size of the bed. Portraits look well when nearly filling the screen unless, of course, the clothes are an important part of the picture. Do not collect all the bright colours you can find when taking colour films, they look much more vivid when projected on the screen and surrounded by black. Light pastel colours blend together much better to form a pleasing effect with the use of bright colours in moderation to attract the attention to the principal part of the picture.

It is more difficult to obtain good lighting for colour than for monochrome because of the limited latitude of colour films. The best outdoor lighting is probably found when the sun is partially obscured by very light cloud but sufficiently bright to cast a distinct shadow. Brilliant sunshine in a vivid blue sky is too hard and casts heavy shadows which tend to be bluish. Diffused light from a completely overcast sky is quite suitable for portrait work but lacks contrast and modelling. The position of the sun should be chosen very carefully according to the effect that is required. A flat front lighting is always uninteresting, but if the lighting is very hard it is advisable to keep the sun behind the camera and within 30 deg. of the line joining the camera and the sitter.

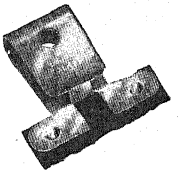
Diffused Sunlight. For diffused sunlight almost any lighting may be used, even photographing into the sun (a lens hood should be used), and very pleasing effects can be obtained when the operator has learnt the limitations of the material he is using. In general, light as you would for monochrome, but do not attempt very contrasty lightings unless you are prepared to experiment and be disappointed several times before producing the effect you require.

Use a projector employing a lamp of not less than 250 watts. For additive systems, where the light reaching the screen is considerably reduced by the mosaic, a strong light is needed, and for both types of process as "white" a light as possible is desirable; this also is achieved by a high wattage lamp running well up to or even slightly above its rated voltage. A white screen should be used, any screen tending to be yellow with age should be avoided. Bead screens are excellent, especially for additive processes, because of their brightness, and aluminium screens are good, especially if they tend to be slightly bluish in colour, because they tend to make the projection light "whiter." The projection lens should be kept specially clean, since a little dust (which soon accumulates on the back of the lens due to the movement of the film behind it) causes a flattening of the picture and a desaturation of the colours due to scatter of white light.

CLEARING BATH. A solution into which a negative or positive is placed to clear it of developer stains. The most common are composed of : (1) alum (2 ozs.), citric acid ($\frac{1}{2}$ oz.), water (20 ozs.) ; or (2) chrome alum ($\frac{1}{2}$ oz.), citric acid (1 oz.), water (20 ozs.). The citric acid may be replaced by half the quantity of hydrochloric acid in either of the first two formulae. No stain-clearing bath is infallible, owing to the great variety and degrees of strength of stains, and they often work slowly, but the characteristic yellow stain of pyrogallol developer will be much reduced.

CLIPS. Clips are a necessary adjunct for the photographer who does his own processing, and are mainly used for hanging up roll-film to dry after development. Two are needed for each spool of film, one to hang it up by and the second to weight the other end so as to prevent the film curling up or being blown into contact with another roll.

When purchasing clips it is advisable to buy them in stainless steel ; clips that rust always prove a nuisance and may ruin a spool of film. A good type of film clip is the Ensign "Spikit." In this, two prongs pierce the film, which is held away from the clip by a conical prong in a recessed hole. The ends of the film are thus completely exposed on both sides, and dry as quickly as other portions of the film.



Ensign "Spikit" Clip

Clips are also used in cine work for holding the film tight on the reel when not in use.

CLOSE-UPS: (1) WITH A STILL CAMERA

David Charles, F.R.P.S.

Author of 'Commercial Photography' and 'Brighter Photography'

It is not generally understood that in taking photographs under conditions in which the camera and subject are at close range there are a number of factors which must be given careful consideration. What these are and the measures required to obtain satisfactory results are here clearly explained

See also Depth of Focus ; Magnification ; Perspective ; Table-Top Photography

It would not appear, at first sight, that the making of a photograph from a point very close to the subject involved any special treatment or consideration. Yet the contrary is the case. There is, of course, a dramatic quality in a small subject photographed at close quarters, as compared with an enlarged image of the same subject photographed from a greater distance. It is not only the greatly reduced grain which produces this result, but also that the combined effects of steeper perspective and reduced depth of definition make details appear to stand out more realistically. Then there are many subjects which, on account of their small size, practically compel a very close approach of the camera. Their images, otherwise, would be too minute to be useful, unless a telephoto lens of more than usual magnification were employed.

Increasing Exposure. It is in the two factors named above, perspective and "depth," that the advantages as well as the dangers of close-up work mainly lie. There is in addition the factor of necessity for increased exposure which also sometimes complicates the problem. It is not often the case that the subject itself requires more exposure simply because it is being photographed close to. But when a subject of dark character is photographed close-up in poor light, undoubtedly the estimated exposure should be considerably increased.

For instance, a piece of ancient oak carving in the corner of an ill-lit hall may require, at the same lens aperture, from four to eight times the exposure given to the interior as a whole. But quite apart from that fact, there are two other considerations in close-up work which necessarily increase the exposure required. One of these is the fact that the camera itself, and the operator, may shade off much of the available light from the subject. The other lies in the increased extension of the camera. For instance, if a small object is being photographed to half its actual size the camera extension will be 1$\frac{1}{2}$ times its normal length ; if the object is photographed to actual size the camera extension will be double its

usual length; namely, twice the focal length of the lens. The implication of this is that with, say, a six-inch lens in use, in the first instance it will be used nine inches from the film; in other words, as a nine-inch lens. In the second instance it will be used as a twelve-inch lens. The net result is that the aperture *f*6 automatically becomes *f*9 in the first case and *f*12 in the second; exposure must be given according to those values; namely, twice as much or four times as much respectively. On outdoor subjects in a good light, and where the "close-upness" is not extreme, these matters do not loom importantly. But on technical work with small apertures where exposures run into minutes, the multiplication of exposure times can reach terrifying dimensions. A useful plan in the latter case is to employ fairly powerful artificial light very close to the subject.





Photo, Winifred Williams; Rolleiflex camera, f11, 1/25 sec.

FINE DETAIL. Examples of the close-up. Note how detail appears to stand out due to the reduced depth of definition *Photo (above), F. A. Partington; Contessa Nettel camera, Kodak Panatomic plate, f4.5, 1 sec.*

Loss of Depth. To those who are familiar with the considerable depth of definition given by the average hand-camera lens it often comes as a surprise to discover the extent to which this quality of depth rapidly disappears as one approaches closer to a subject. The advantage lies in being able to get a sharp subject to stand out from a diffused background, or even the

principal details from subordinate ones. The disadvantage lies in the considerable stopping down of the lens which is necessary when depth of definition is desired. To take a by no means extreme example, if a flower or other small subject is photographed to about its actual size with a three- or four-inch lens, keen definition of detail will be confined to a depth of much less than one inch of the subject, even at the smallest aperture to which the diaphragm can be closed.

Perspective Distortion. The question of the perspective obtained at close quarters is of the greatest importance, whether the subject be a portrait or a packet of tea. The difference is that in a rectangular object the falsity of perspective when conditions are wrong is at once obvious and absurd, but in the case of a portrait photograph the dissatisfaction is usually felt rather than analysed.

What happens is that the nearest feature (usually the nose in a portrait) is too great in size, and the other features are made to slope away too abruptly. In order to prevent this very common fault the only possible procedure is to use a long-focus lens upon a camera of correspondingly greater extension capacity. The virtue of this lies in the ability thereby to obtain an image of the desired size while approaching not so close to the subject as to produce objectionable distortion.



FROM GROUND LEVEL. Although there is some falsity of perspective is this close-up photograph, it is not so pronounced as to distract from the general effectiveness. Distortion of features nearest the camera is a common fault in the majority of close-up pictures
Photo, Lynx

CLOSE-UPS: (2) IN CINE WORK

The close-up shot is essential in cinematography, for without it a scene or action becomes devoid of vitality. Here Mr. G. S. Malthouse explains the special features of the close shot and how it should be utilized in amateur cine work

The invention, or, more properly, the discovery, of the great virtue of the close-up and parallel action (*see* under the heading Cinematography, Amateur : Advanced Methods) by D. W. Griffith was, and still remains, one of the greatest contributions to the art of the cinema. In the early days of the film whole sequences were shot from one position, so that the effect was that of a photographed stage play. The cine camera should be regarded not only as a recording instrument but also as a participator and interpreter of the scenes and events it records. It should therefore get as close to the subject as possible, peering into and recording every material aspect of it.

Most beginners tend to film almost entirely in medium and long shot; the audience is never allowed to "come to grips" with the subject, but see it only from a distance. The salient features of a scene or action should be shown in medium close-up or close-up; *e.g.* in a sequence showing an angler landing a catch, the essential feature—the fish—should be shown large on the screen. Facial expressions should be shown in bold close shot (the supreme contentment of a child licking an ice, or mother's annoyance at having dropped

a stitch) if only for the fact that those expressions would not register adequately from a distance.

When taking close-ups of people a longer focal length than the normal 1-inch is an advantage, since it enables the cameraman to stand farther away from the subject, who is thus less likely to be self-conscious. Another virtue of the longer focal length lens is that it has less depth of focus, so that the background is fuzzy and throws the subject into relief. Backgrounds should be neutral in character. In the case of close-ups of people and animals it is frequently an advantage to film from a low viewpoint so that the only background is the sky.

In addition to its value as a "seasoning" to a film, the close-up is an economy, since it is often possible to show in one bold, revealing shot what could not be conveyed with as much clarity and forcefulness by a considerable number of shots; *e.g.* A man impatiently awaits a visitor. He smokes a cigarette. Close shot of ash tray with one stub in it. Dissolve to ash tray containing a large number of cigarette ends, thus indicating with the minimum number of shots the passage of time. (*See* Dissolve and Continuity.)

The footage of the close shot needs to be shorter than that of the long and medium shots, for since interest is concentrated exclusively on one particular object an audience needs less time to assimilate it. Where a process is shown (*e.g.* needlework, painting, pottery, etc.) the close shot must be held on for a sufficient length of time to enable the audience to see clearly just how the various operations are performed. But where the close shot is used for "atmosphere" it should be kept very short; *e.g.* a close shot of a glassful of wine in a sequence showing Christmas festivities should be little more than a flash on the screen, for the audience is not interested in the glass *qua* glass, but only in the jollifications it typifies. It should, therefore, be held on just long enough for them to recognize it clearly, but not long enough for them to analyse it.

The proportion of close shots to medium and long shots in a film should rarely be less than one-fifth, and can almost always be more.—*GORDON S. MALTHOUSE.*

CLOUD PHOTOGRAPHY: METHODS AND MATERIALS

Bernard Alfieri, Jr.

The art of cloud photography is well worth close study, for its intrinsic interest and on account of the importance of cloud effects in many pictures. An understanding of light filters, the colour sensitiveness of various films, and methods of printing, as described here, will enable the photographer to acquire the requisite skill

See also Combination Printing

CLOUD shapes and the subtle tones that go to make a sky have always appealed to photographers, not only because sky negatives are useful for printing into cloudless subjects, but for the beauty of the sky itself and the ever-changing shapes that help to complete a picture and add a sense of distance and general atmosphere.

Unfortunately, the camera and the human eye do not always see a sky in the same way, although improvements in sensitive material and the judicious use of light filters have brought the subject within the scope of every photographer.

Light Filters. The so-called colour-blind plate or film is chiefly sensitive to blue and ultra-violet, and would render the blue of a sky as white. Orthochromatic films, sensitive to green and yellow, and panchromatic films, which are sensitive to every colour of the visible spectrum, are still, though in a lesser degree, very sensitive to blue and violet. With a colour-sensitive emulsion and correct exposure there should be no difficulty in obtaining good cloud renderings in a straightforward manner; but we usually want to increase the contrast of the cloud shapes and still retain as little contrast between the sky portion as a whole and the landscape, for which purpose a light filter is essential. A very pale yellow filter which will barely double the exposure



DRAMATIC SUNSET SKY. The bright edges of the dark clouds are markedly contrasted and the sharpness of the outlines gives the clouds a solid appearance which may be compared with the more billowy effects in the photographs in pages 349 and 350. The whole has a finely dramatic quality

Courtesy of Leitz-Werke, Wetzlar; Leica camera

is quite sufficient to cut out all the ultra-violet and considerably deepen the blue tone of a sky, thus ensuring a good sky rendering on general landscape negatives.

Where sky negatives are required for special purposes, or for printing into other negatives, it is an advantage to increase the contrast considerably. This can be done by using a deeper filter or one that is more drastic in its colour absorption, employing a slower and more contrasty film, the greatest contrast being obtained with an infra-red plate and special filter.

For clearness, the following alternatives have been arranged in their order of contrast :

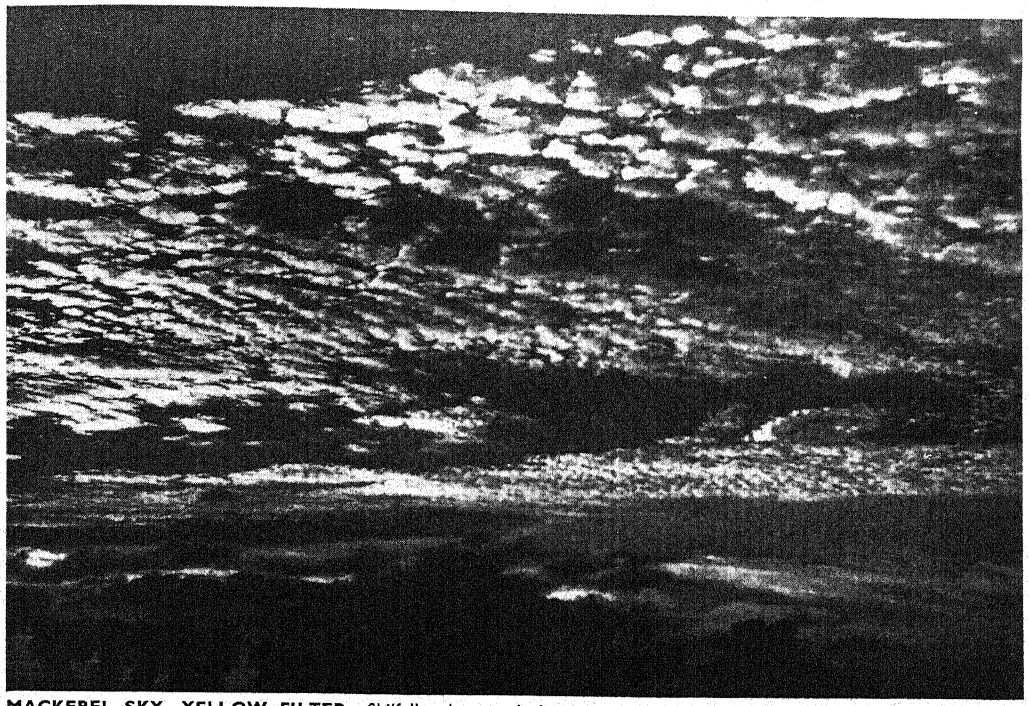
Fast orthochromatic or panchromatic film, without filter.	Weak cloud effects.
The same film but with pale yellow filter.	Stronger cloud rendering.
Slow film of a similar type.	About the same cloud contrast, but often great contrast between sky and landscape.
Fast film of the same type used with deep yellow, or green filter.	Much stronger clouds, with not too great a contrast between sky and landscape.
For Sky Subjects only	
Fast ortho. or pan. film, with red filter.	Increased contrast, blue sky nearly black.
Very slow pan. film, with filter.	Still more contrast.
Infra-red film and filter.	Greatest contrast of all. Blue sky absolutely black.

When photographing clouds, with or without a filter, a good lens hood should be used.

Great care should be taken never to point the camera at the sun. With a focal-plane blind, and the lens focussing a reduced image of the sun itself on the shutter, it is quite possible to burn a hole in the blind, and even set the film on fire.

This is apart from the undesirability of direct sunshine on the lens. On the other hand, where the sun is behind a dense cloud, against the light pictures of cloudland, and brilliant outlines to the clouds, probably combined with shafts of light, never fail to provide good subject matter. Many skies are particularly attractive for their colouring, and it is as well to remember this when selecting subject matter that will be rendered in black and white. Skies full of detail and small separate cloud shapes often attract the eye, but when photographed present a lack of general outline and composition which is disappointing. Bold skies, with a main shape arranged in such a position that they may be useful for printing into other pictures, usually prove the most satisfactory, and if their ultimate object is to be overprinted on other photographs there are a few points that must be considered.

The collection of cloud negatives should not only contain such general types as bold



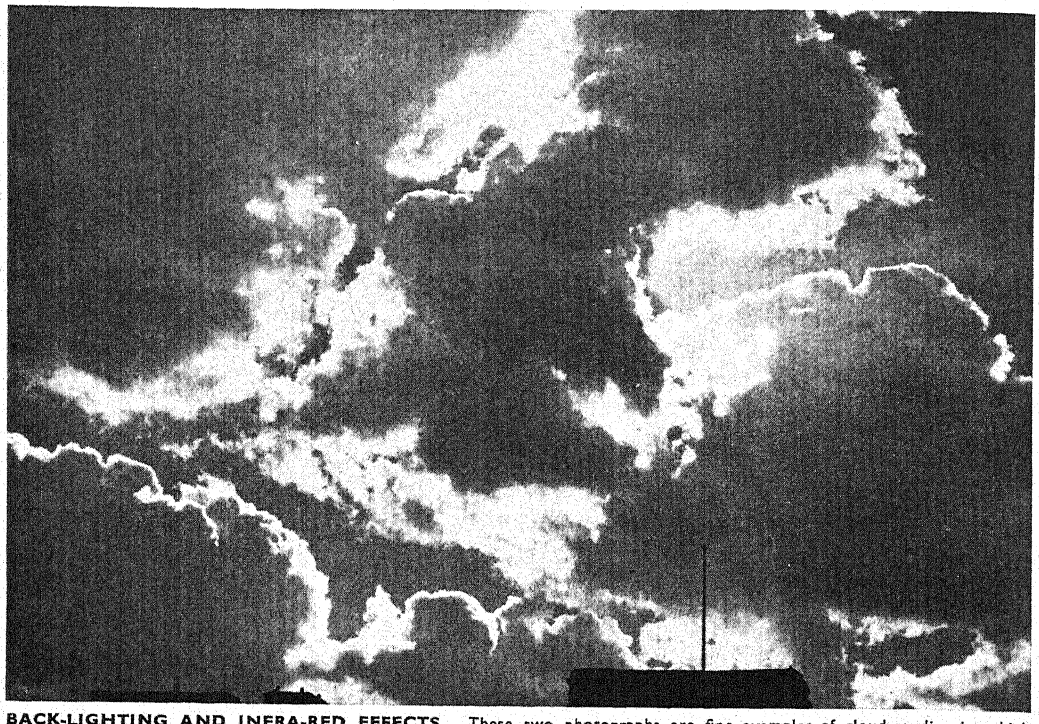
MACKEREL SKY—YELLOW FILTER. Skilfully photographed cirro-cumulus clouds, taken with the assistance of a deep yellow filter. The filter brings out the strong contrast between the clouds brightly lit by the setting sun and the obscure landscape

Photo. Bernard Alfieri ; 1/10 sec., f3.5, med. fast pan. film



HIGH CLOUD—INFRA-RED FILTER. By the use of an infra-red filter this sky scene (over Wisley Common, Surrey) is given great depth and the clouds appear to fill a vast space, showing white against the unnaturally dark sky. While it is strictly an unnatural colour rendering in monochrome, it is the most effective way of obtaining really strong cloud contrasts

Photo, Bernard Alfieri, Jr.



BACK-LIGHTING AND INFRA-RED EFFECTS. These two photographs are fine examples of cloud studies in which careful regard has been given to vantage point and moment of exposure. The impressive picture seen above was obtained by watching the movement and changing form of the cloud mass until, with the sun obscured, all the beauty of the clouds in light and shadow appeared. In the photograph shown below the view extends to thirty miles and this and the remarkable rendering of the cloud layers are due to the use of infra-red material and a special filter

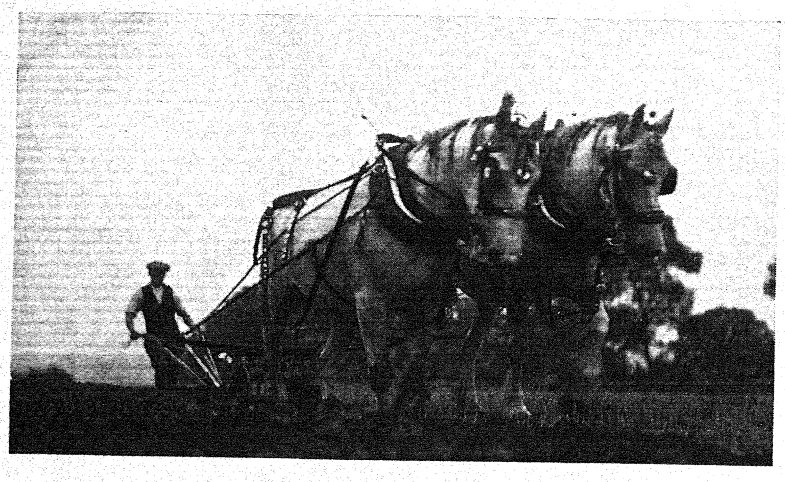
Photos (top) Topical : (bottom) D. W. Bradford; f32, 3 sec.

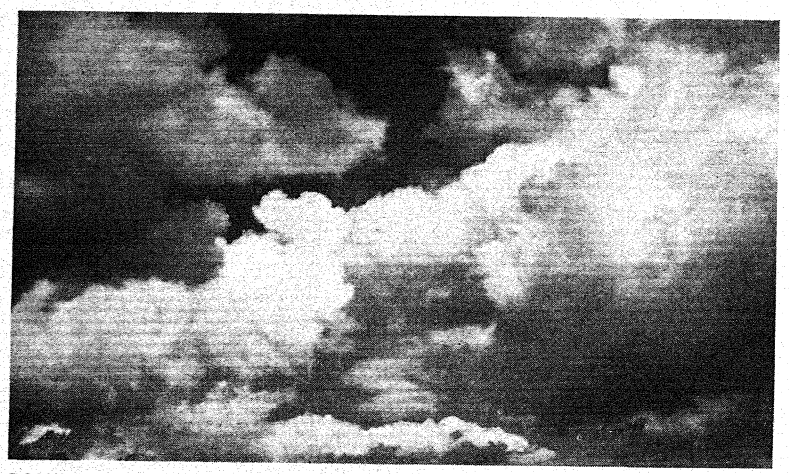


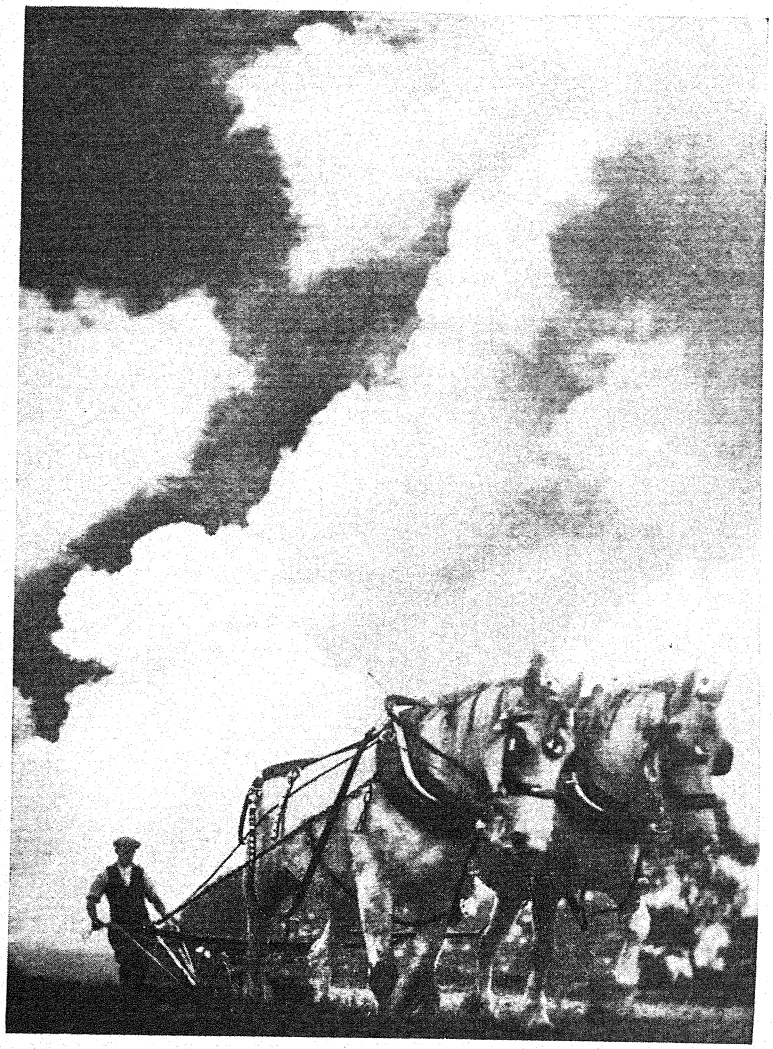


WIND-BLOWN EVENING SKY. A deep yellow filter has been used to emphasize the still bright heights of cloud, in contrast to the sombre earth and dark cloud linings. An excellent example of the legitimate use of a deep, over-corrected filter

Photo, Bernard Alfieri ; med. fast pan. film, 1/20 sec., f4.5







COMBINED IMAGE. The perfected final picture, shown on the right, is a " married print " made from two selected negatives, as described in page 353. The cloud negative has been enlarged and a portion only used. By this method different filters, film, etc., can be chosen to produce the results desired from two subjects photographed under unlike conditions

Photos, Bernard Alfieri, r.

white cumulus, wind-blown clouds, mackerel sky (cirro-cumulus), sunsets, etc., but should have examples of each lit from different positions, moving in various directions, and negatives of various contrasts.

It is possible to collect a large number of cloud negatives which never seem to fit in with any subject lacking a sky, and once such a subject is ready the skies must be examined not only for general suitability, but care must be taken to see that the sky is lit from the same direction as the landscape and that the clouds appear to be travelling with the wind as depicted in the companion negative.

Also, though we may all try to produce ideal negatives of a standard density, it is impossible to avoid varying contrasts, and care will have to be taken to select a sky that will print satisfactorily on the same grade of bromide paper that is selected for the other part of the subject.

For these reasons it is obvious that a large selection of sky negatives will be required if the best possible results are to be obtained.

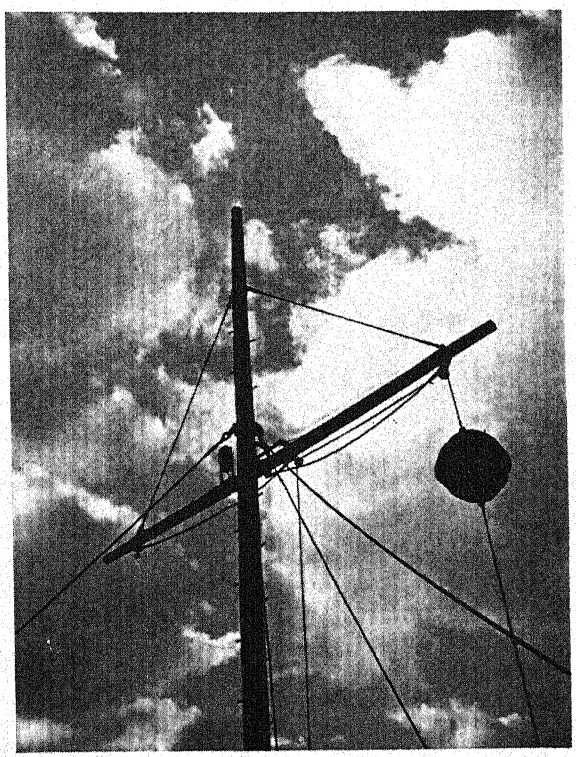
In the early days of pictorial photography it was considered a fake to insert a separate sky. In modern photography, to use a separate sky might be viewed with disapproval if it were known; but in the interest of pictorial expression there can be no real objection, and the whole success of the result must depend on whether it can be detected. If it is correct, from the point of view of nature and lighting, a printed-in sky not only improves a subject but may be the chief attraction, and the verdict must depend on the taste and skill of the photographer.

Methods of Double Printing. Double printing with an enlarger is a very simple matter. Having selected the skyless subject and a suitable cloud negative, the former is focussed on to a plain piece of paper placed on the enlarging easel, and a pencil outline is roughed round the main portions of the subject.

The sky negative is now placed in the enlarger and arranged, reduced or enlarged to fit in aptly with the first subject, as shown by the pencil outline.

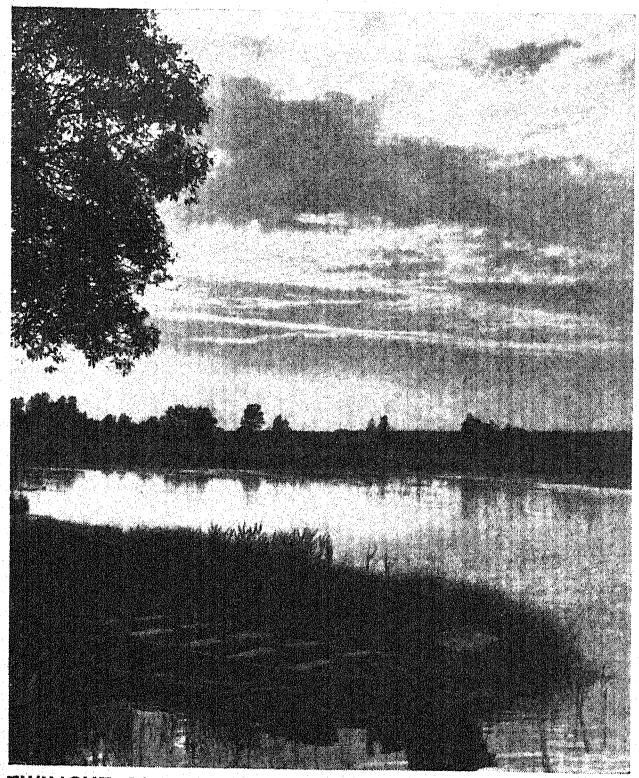
A test exposure is now made to ascertain the correct exposure, and, the bromide paper being placed in position, the exposure is given, whilst that part of the subject which is to be printed from the second negative is shaded during the first printing. Putting back the plain paper in the same position, the other negative is re-focussed within the outline pencil and the original piece of bromide paper is substituted, holding back the sky portion, whilst the main subject is printed.

An alternative method is to print the landscape portion and develop sufficiently to show a faint subject, after which the bromide paper is rinsed, the surplus moisture being dried off with a soft rag and replaced on the printing easel. Covering the enlarger lens with a deep yellow filter, the sky is now arranged directly on to the bromide paper, after which the filter is removed and the



MAST SILHOUETTE.—By photographing the mast against the light the distant clouds are given an appearance of considerable depth. Good sky photography, as here demonstrated, should reveal clouds as masses in space by means of colour contrasts in the sky itself

Kodak Snapshot, Panatomic film, 1/50 sec., f11



TWILIGHT SCENE. The delicate cloudbanks in this photograph contrast well with the deep shadows in the foreground and the silhouetted landscape, the whole providing a dramatic effect and suggestion of tranquil twilight
Photo, Press Topics

second exposure given in the usual manner, when the bromide paper is developed and fixed.

Where a number of duplicate prints may be required at a later date and the sky must not be detected, it is a good plan to finish off the first print and dry this in the usual way, after which it can be kept for darkroom use and be used on the enlarging easel as a guide for determining the exact size and placing of the two subjects. The relative tone value between sky and landscape must be considered. It is always safer to combine a light sky with a dark foreground, although really heavy skies are the most striking. Again, great care must be taken not to combine a very brilliant contrasty sky with a dull, even if heavy, landscape. Sometimes a pleasing effect can be produced, but it is not convincing, usually on account of one of these reasons. There are subjects the whole character of which can be changed by the particular sky that is employed, whilst others seem to need a particular type of sky and look wrong with any other.

A sky can give the impression of sunshine even if it is not sunlit, and this will obviously look wrong on a dull foreground, whilst a dull sky above a sunlit landscape may look even worse. It sometimes helps the general effect to print the sky portion slightly out of focus, or to diffuse it in the enlarger, which in the case of a sharp, bold foreground motive carries a conviction of correctness, apart from the fact that it may help to make the principle part of the subject predominate.

Sky photography and its application to landscape work must remain a matter of personal taste, and the success depends on the skill of the photographer.

COLLODION. Solution of pyroxyline (*i.e.* cotton treated with nitric acid) in a mixture of equal parts of alcohol and ether. Collodion has a more important position in the history of photography than in modern times, though the wet and dry collodion processes are of importance in blockmaking (*see* Photo-Mechanical Processes). The first wet plates were coated with albumen as a carrier for the silver iodide; it was in 1851 that Scott Archer introduced collodion to replace albumen in this capacity, and this method was followed for at least a quarter of a century. Collodion is a transparent and gelatinous liquid, which, after the evaporation of its solvents, leaves a thin, transparent film of pyroxyline on the surface.

In the early days of photography the worker made each collodion plate as it was required, coating his glass with collodion and then dipping it in nitrate of silver. In modern times the photographer is likely to encounter collodion only as an emulsion of self-toning printing-out papers for daylight use. These are advantageous in hot summer weather, when not only are gelatine papers liable to become damaged, but also bright sunshine is available for the daylight printing.

Points to note in the use of collodion self-toning papers are: (1) choice of negative,

which must not be thin or dense, or lacking in detail with few or no half-tones ; and (2) the necessity in printing to aim at producing a tone somewhat darker than the desired result. *See* Printing-Out Papers.

COLLOTYPE. A name given to one of the older photographic reproduction processes by means of which illustrations resembling photographs can be printed on paper.

The collotype process is based upon the fact that when a film of bichromated gelatine is exposed to light under a negative the gelatine becomes insoluble in proportion to the light-action which it has received, and also loses its power of absorbing water and so repelling greasy ink. The process is not one which can very well be worked at home by an amateur, since it requires a printing press and very considerable experience and skill in the details of its manipulation. For the sake of interest, however, a brief description of the process is given here.

A sheet of plate-glass has one of its sides finely ground with a mixture of emery powder and water. The plate-glass is then placed, ground surface upwards, upon a perfectly level board and a mixture of waterglass (sodium silicate) and albumen is applied to it so as to form a very thin layer. This preliminary coating forms a substratum for the gelatine layer, which is placed on top of it.

When the waterglass-albumen layer is perfectly dry the plate is coated with a solution of gelatine containing potassium or ammonium bichromate. The plate is then allowed to dry in a dust-free oven at a temperature of approximately 120° F. When dry it is sensitive to light. It is now exposed (usually to the light of an arc lamp) under a negative, the necessary exposure being carefully timed by means of an actinometer or exposure meter. After exposure the plate is washed in water to remove the unaltered bichromate. Finally it is dried at a carefully controlled temperature.

In order to prepare the plate for printing, a mixture of pure glycerin and water is poured on to it and allowed to remain in contact with it for about half an hour. During this time the gelatine repels the glycerin solution in exact proportion to the light-action which has taken place on its surface. Thus the white areas or high-lights of the image (which have been represented by the denser portions of the printing negative and have thus received the least light-action) will absorb the largest amount of glycerin solution, whilst the dark areas of the image (which have received the most light-action during printing) will absorb practically none of the glycerin.

The excess glycerin solution is ultimately removed from the plate and the latter is placed in a printing press. A specially designed roller charged with a thick, greasy lithographic printing ink is passed several times over the plate. The areas of the plate which have absorbed the most glycerin solution will, being in a moist condition, repel the greasy ink, but those portions of the plate which have repelled the glycerin and are now fairly hard and dry will retain the ink. Thus the high-lights of the image will remain uninked, the various shades and shadows of the picture being inked at different intensities.

Making a Collotype Print

When the plate is satisfactorily inked according to the judgement of the operator, a sheet of good-quality paper is laid over it and brought into firm contact by means of the press. A collotype print of the original photograph is thus produced and if careful attention has been paid to the many working details of the process the result will be a very fine reproduction in printer's ink of the photograph.

Collotype prints may be produced in any colour of ink and, by adopting certain modifications and extensions of the process, it has been commercially possible to produce collotypes in " natural " colours.

The collotype process has been known at different times by a variety of names, among which may be recorded *Artotype, Albert-type, Photophane* and *Phototype.* As a commercial photo-mechanical printing process, however, it has been largely superseded by the quicker and less limited half-tone and rotary-photogravure processes. Actually, only about five hundred prints may be produced from a single collotype plate. Hence, despite the excellent reproduction afforded by the collotype process, the latter is not adapted to mass-scale and high-speed photo-mechanical printing.

COLOUR PHOTOGRAPHY: (1) GENERAL PRINCIPLES

D. A. Spencer, Ph.D., D.I.C., F.R.P.S.

President of the Royal Photographic Society : Author of "Photography Today"

In this, the first of a long series of articles dealing with every aspect of Colour Photography in its modern developments, Dr. Spencer, long associated with experimental and technical work in colour, introduces the subject authoritatively and sums up in general on the lines of probable development. After this general introduction the following sequence of articles is presented :

(2) ADDITIVE PROCESSES
Autochrome (Lumière Filmcolor), Dufay and Finlay—by three experts on the processes

(3) SUBTRACTIVE PROCESSES
Kodachrome, Agfacolor, Vivex and Gasparcolor—four articles by authorities

(4) COLOUR PRINT PROCESSES (PAPER)
A general article

(5) PIGMENT PROCESSES (PAPER)
Trichrome Carbro and Duxochrome

(6) IMBIBITION PROCESSES (PAPER)
Pinatype, Jos Pé, and Eastman Wash-off Relief

(7) TONING PROCESSES (PAPER)
Chromatone, Tri-Tone, and Photocolor Bi-Chrome

(8) NOTES FOR AMATEURS
by a worker in colour

In the main heading under each group full details of the processes and subjects discussed, with authors' names, are given, the whole forming a comprehensive guide to all important branches of modern colour photography

See also Dyes used in Photography ; Technicolor

EVER since the birth of photography it has been the desire of all serious workers to take pictures in natural colours. Since 1855, when Clerk-Maxwell first conceived the idea that the three-colour principle might be applied to photography so as to reproduce objects in their natural colours, ceaseless research has been carried out in this branch of photography, and hundreds of colour processes have been suggested. Many have never passed beyond the theoretical stage, while others have long since been superseded.

The Patent literature suggests that a process of colour photography is invented every week, but of these the vast majority never reach a practical form.

Those in which the various technical problems of manufacture, exposure, processing and projection have been successfully worked out and turned into a commercial proposition are not numerous, but show results of a very high order of excellence.

It must be admitted, however, that until about 1930 relatively few amateur photographers were actively interested in colour photography, and of these it is safe to say that 90 per cent. produced their results by additive transparency systems. Since that time the case has altered and, thanks to the processing efforts of photographic manufacturers, even those whose cameras cost as little as 30s. can make colour photographs by either additive or subtractive processes.

White light is composite in nature, and when passed through a prism or reflected to the eye from spherical rain-drops the constituent rays are spread out by refraction into a multicoloured band called a spectrum and a rainbow respectively.

If, by suitable optical arrangements, the coloured rays were to be reflected back along their original track, white light would be re-formed. If, however, this reflection was performed by a surface which absorbed, say, the red coloured rays, reflecting only the violet, blue, green and yellow, it will be found that the reflected rays, when combined, give a blue-green colour.

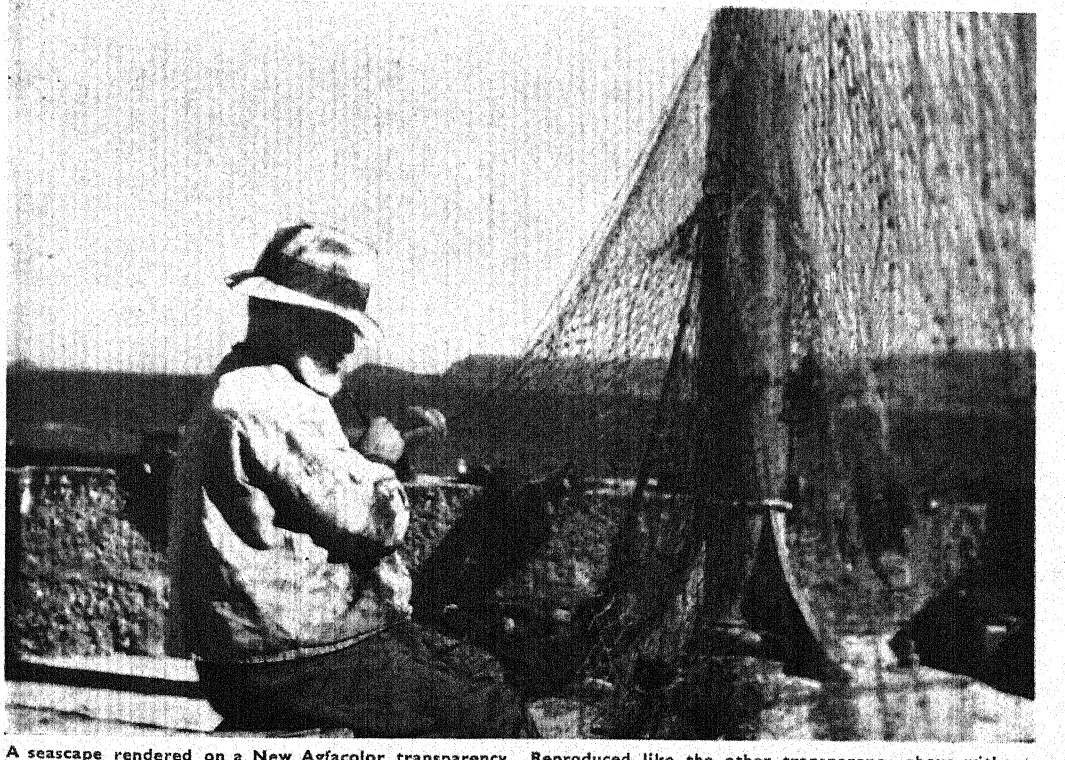
Blue-green is, therefore, built up of all the coloured rays in the spectrum except those at the red end. It follows that a surface which subtracts the red rays from the white light, reflecting the remainder to the eye, will appear blue-green in colour.

When blue-green is formed by adding together separate coloured rays of light, it is called an *additive* blue-green. When, however, blue-green is obtained by reflecting white light from a surface which absorbs or subtracts the red rays, it is called a *subtractive* blue-green. Practically every colour occurring in nature is a subtractive colour, for the colours we see are really daylight



This delightful country scene is reproduced direct from a Kodachrome transparency without retouching or other control other than the normal processes of three-colour half-tone reproduction

Photo, A. K. Rittener, A.R.P.S.; Kodachrome film 1/50 sec., f5.6; by courtesy of Kodak, Ltd.



A seascape rendered on a New Agfacolor transparency. Reproduced like the other transparency above without retouching or control A faithful rendering of a not too easy subject. Exposure 1/20 sec. at f4.5

Photo, Bernard Alfieri, Jr.

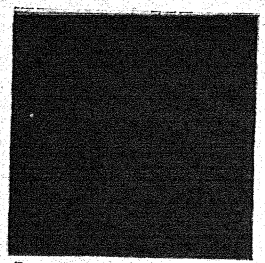
COLOUR TRANSPARENCIES BY SUBTRACTIVE PROCESSES: KODACHROME AND AGFACOLOR

See articles on Kodachrome (p. 372) *and Agfacolor* (p. 376)

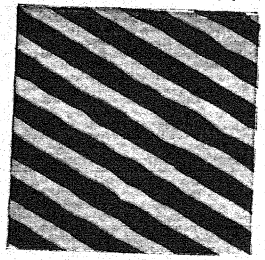
ADDITIVE COLOUR PROCESSES

Photomicrographs of Dufaycolor Réseau

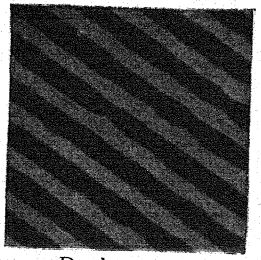
Magnification × 100 (taken on Dufaycolor film)



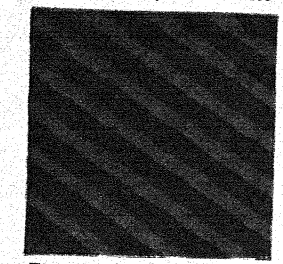
Base dyed blue and over-printed greasy resist lines



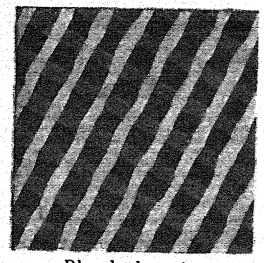
Blue bleached out



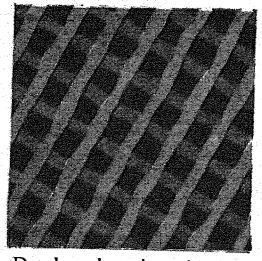
Dyed green



First resist washed off and reprinted at right angles

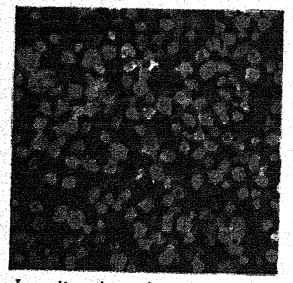


Bleached again

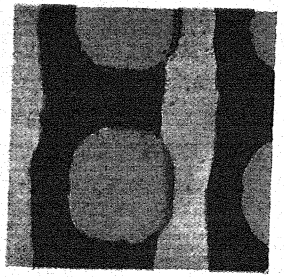


Dyed red and resist removed to give final réseau

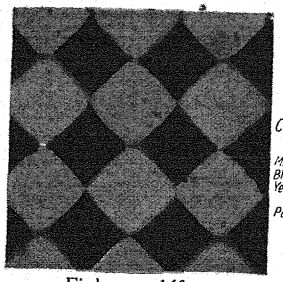
SCREEN MOSAICS



Lumière Autochrome × 160



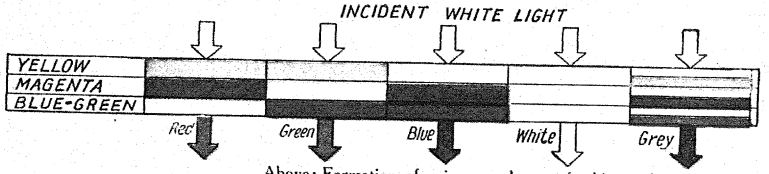
Paget Leto × 160



Finlay × 160

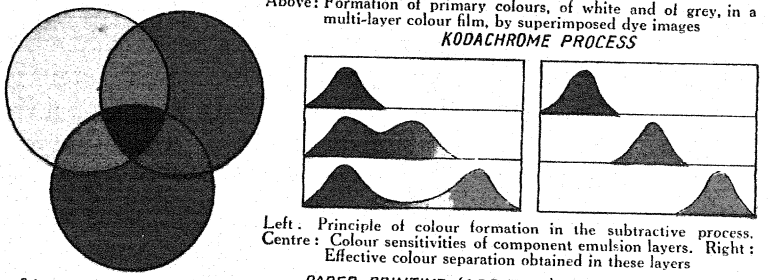
Rebroduced from "The Photographic Journal" (R.P.S.)

SUBTRACTIVE COLOUR PROCESSES

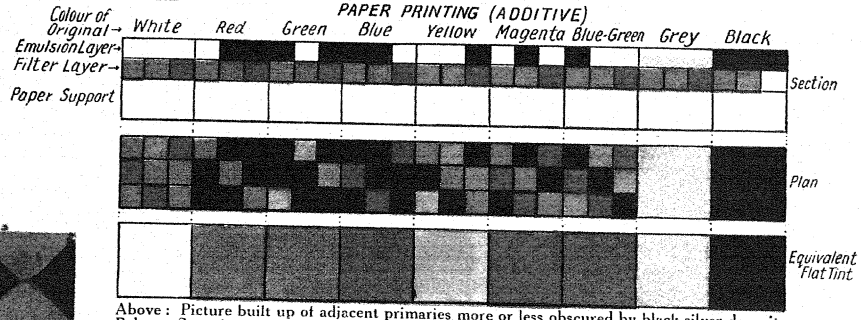


Above: Formation of primary colours, of white and of grey, in a multi-layer colour film, by superimposed dye images

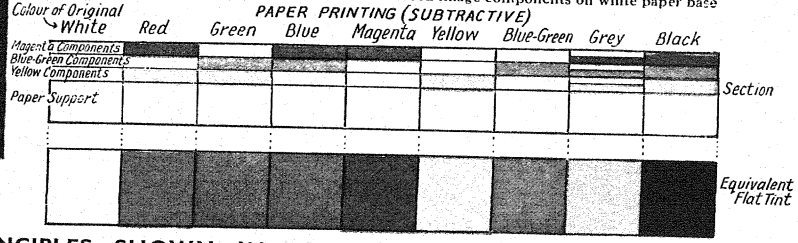
KODACHROME PROCESS



Left. Principle of colour formation in the subtractive process. Centre: Colour sensitivities of component emulsion layers. Right: Effective colour separation obtained in these layers



Above: Picture built up of adjacent primaries more or less obscured by black silver deposit.
Below: Superimposition in register of three coloured image components on white paper base



MODERN COLOUR PHOTOGRAPHY: THE PRINCIPLES SHOWN IN DIAGRAM FORM

This series of diagrams illustrates the principles of the chief processes of colour photography of practical importance in modern work. Left: Additive screen processes. Top right: Kodachrome subtractive process. Bottom right: Paper printing processes, additive and subtractive compared

To face page 357

reflected to our eyes, but minus those rays which are selectively absorbed by coloured objects.

When, as in the case quoted, two colours together comprise the whole of the visible spectrum, they are called " complementary colours." Thus red is the complementary colour of blue-green, and yellow is complementary to blue.

If the visible spectrum is divided into three approximately equal parts and the radiation in each portion is grouped together, red, green and blue lights are obtained. Obviously if the three resultant coloured lights were added together we should re-form white light, for every radiation present in white light would be present in the mixture. Clerk-Maxwell showed, however, that by combining lights of these colours in suitable proportions, every colour in nature could be matched and the so-called " additive " processes of colour photography are based on this discovery.

If, instead of the primary coloured blue-green and red lights suitable mixture of pigments of the complementary or minus colours are made, again the colours of nature can be imitated—the complementary coloured pigments in question being the familiar artist's primaries, yellow, magenta and blue-green (commonly, but inaccurately, called yellow, red and blue), and the processes of colour photography based on the use of such pigments are called " subtractive " processes.

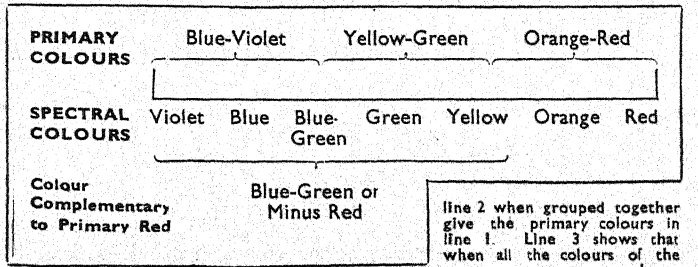
Analysing the Light

If a blue filter is placed in front of a camera lens, only those rays of light in the blue region of the spectrum will reach the photographic plate. Accordingly, when the negative is developed the silver deposit obtained is due solely to the blue rays reflected from the object on which the camera is focussed, and the density of the deposit at any point is determined solely by the amount of blue reflected to that point from the subject. Blue light intensity has been translated into equivalent opacity : and such a negative is often described as a " blue-sensation " negative.

To complete the analysis of the colours of the subject, negatives which are a record of the green rays and the red rays are made through green and red filters. Although panchromatic material is nearly always used for all three records, this is obviously not essential, and in some types of one-shot camera the blue record is made on a " colour blind " ordinary plate, the green record being made on an orthochromatic plate through a yellow filter.

Additive Colour Processes

Consider the nature of a positive transparency print from the negative made through the red filter. For the sake of simplicity, assume a piece of red paper has been photographed on a green and black background. In the negative, wherever red light fell on the plate, a deposit of silver is obtained and, therefore, in the transparency this portion of the plate will be, more or less, transparent. On the other hand, the green rays reflected from the green background, being absorbed by the red filter (which it will be remembered absorbs all but red rays), will be without effect on the negative and the latter will be free from silver deposit in the regions corresponding to the green parts of the background. No light reaches the plate from the black areas, since they appear black only because they do not reflect light of any sort. As a result, the transparency print from this negative will be opaque in these regions. If the resulting transparency is projected through a red filter on to a screen, a red image is obtained which is a record of the red rays reflected from the original object. Wherever there was no red in the original subject photographed, it is clear that there will be no red



COLOUR PRINCIPLES. Chart showing the relationship between spectral, primary, and complementary colours. The spectral colours listed in line 2 when grouped together give the primary colours in line 1. Line 3 shows that when all the colours of the spectrum except red are grouped together, the result is blue-green or, more correctly, " minus red " light

on the screen—only black. The same argument applies to transparencies from the green and blue filter negatives projected through the green and blue-violet filters.

If by using three lanterns, these three-coloured images are projected on top of each other and in register, then since every colour is approximately matched by mixing appropriate proportions of the three primary colours, and since this proportioning has been accomplished by the original silver deposits, a picture in correct colours is obtained.

Since the coloured result is obtained by adding together appropriate proportions of the primary coloured lights, this method is known as "additive." In order to reduce this system to a practical form which has made its commercial application possible, all three records are made upon one plate or film through colour filters which are of microscopic size intermingled in close juxtaposition—the so-called "mosaic screen" processes.

Mosaic Screen Colour Processes

The Lumière Autochrome is a typical mosaic screen plate. To produce the screen elements three equal portions of potato starch grains are dyed respectively red, green, and blue-violet. The dyed grains are then mixed together, and the mixture dusted on to a glass plate covered with a tacky coating. The surplus grains are brushed off and those adhering to the plate are flattened out under great pressure. Upon this mosaic a panchromatic emulsion is coated, and the resulting plate exposed with the mosaic nearest to the lens.

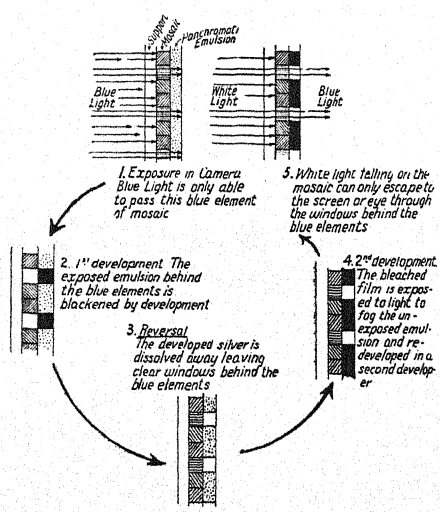
If a photograph of a red object is taken upon such a plate, the red rays from the object pass unhindered through the tiny red elements of the mosaic and affect the emulsion, with the result that after development there is an opaque silver deposit exactly underneath each red element. The red rays are, however, absorbed by the green and blue elements, and the emulsion under these elements is, therefore, unaffected. The developed plate is now placed in a solution which dissolves out the silver image but leaves the unexposed emulsion unaffected. After leaving this bath, therefore, the plate is transparent under the red elements. The unaffected emulsion under the green and blue elements is now blackened by a second development, and in consequence, when the plate is viewed by transmitted light the latter is only able to pass through the red filter elements and the area in question appears red.

Blending of Colours

In the case quoted we have considered the reproduction of a red which is spectrally simpler than the red of the colour mosaic. The majority of colours are of course more complex than this, and varying proportions of the constituent rays will pass through all three elements, producing behind these elements varying degrees of opacity which, after the reversal process, become varying degrees of transparency, allowing appropriate proportions of each of the three colours to pass. These are blended into one on the screen or confused together by the eye to simulate colours corresponding to the original colour.

All mosaic screens are based upon the same general principles, differing from each other chiefly in the methods by which the mosaic is produced—the mosaic of the old Agfacolor process consisting of coloured resin particles, but the Dufaycolor and Finlay mosaics are *réseau* mechanically printed patterns.

In the Finlay system the emulsion and the photographically produced mosaic of microscopic filters are carried upon two separate glass plates which are exposed in contact, face to face. Transparency prints from the negative are bound up in register with



MOSAIC SCREEN. How colour is reproduced by a mosaic screen plate. The mosaic forms a layer between the glass support and a coating of panchromatic emulsion. The latter is sensitive to all colours, and the coloured elements act as filters

a geometrically identical mosaic. The mosaics are seen to be in checkerboard pattern.

The manipulation of these additive screen plates presents no great difficulty to any photographer, and when transparencies (lantern slides, etc.) are required the additive processes provide the simplest means of obtaining these. (For working descriptions, *see* pp. 364–371.) Unfortunately, additive processes in practice are limited to such transparencies for the following reason :

In the additive processes the brightest portions of the picture—the whites—are made up by adding together the three primary lights : red, green and blue. Each of the filter elements is acting by absorbing at least two-thirds of the incident white light, and therefore when an additive picture is placed on a white paper base at least two-thirds of the white light passing through the filter elements on its way to the paper base will be absorbed and cannot, therefore, reach the eye, so that even the whites of an additive picture will send to the eye under ideal conditions not more than one-third of the light which the paper base itself is capable of reflecting. Moreover, white paper appears white not because it reflects all the light that falls on to it, but because it does not exercise a selective absorption upon this light, but reflects every ray in a similar proportion, and there is a further 20 per cent. loss of luminosity due to this cause. In consequence, by the time, for example, the red rays from the red filter element have reached the eye, the light loss is so considerable that the colour appears to be a very dark red indeed. It is not, therefore, practicable to view an additive screen plate image by backing it with white paper, although a dull picture can be seen if a reflecting backing of silver foil is used.

Subtractive Processes

In additive processes we start with a dark screen and build up a picture by adding together coloured lights. In nature, substances are not coloured in this way, but instead they absorb or subtract certain portions of the visible spectrum of white light and reflect the remainder. It is this composite reflected portion which is the colour the eye records as the natural colour of the object, and this phenomenon is the basis of the " subtractive " processes.

The relationship between the additive and subtractive processes can be most clearly grasped after a consideration of the functions of the three silver transparencies used in the original additive process described above (pp. 357–358).

Action of Opaque Areas

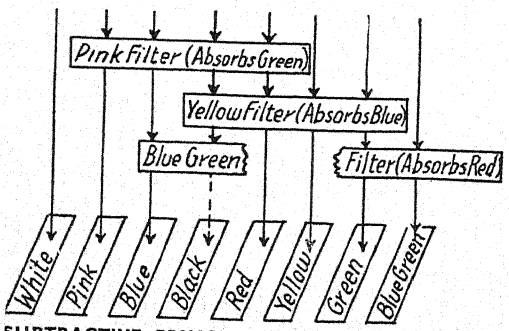
The taking filters used to obtain the separation negatives from which these transparencies were made were defined by the fact that each transmitted one-third of the visible spectrum and absorbed the remaining two-thirds. In the positive transparencies, therefore, the clear glass areas are those through which one-third of the spectrum (the red, say) is to pass, and these areas are coloured red on the screen by projecting the image through a red filter. It follows, therefore, that the duty of the opaque areas on this transparency is to control the amount of red light that reaches the screen in any particular area. The presence of the silver deposit in the transparency means, therefore, either that there was little red in this portion of the subject or that the colour of this portion was not red at all. Notice, however, that the silver deposit must not prevent the rest of the spectrum from reaching the screen, or no colour picture could result, and in the case under consideration it has no opportunity of doing this because these other coloured rays are coming from separate light sources.

But for a print on paper, only one light source can be used, namely, the light which after falling on the paper is reflected back to the eye.

The black silver deposit must, therefore, be converted into one which, while absorbing all the unwanted red rays from the incident light, will yet allow all the rest of the spectrum to pass unhindered. This is accomplished by turning the opaque silver image into a transparent blue-green—that is, turning it into a colour filter which transmits every portion of the spectrum except red (*see* p. 357). For this reason the blue-green is frequently referred to as " minus red " ; it is white light minus the red portion of the spectrum. In the same way yellow is the complementary colour to blue and is called " minus blue," and the bluish pink which is the complementary colour to green

is called " minus green." Although it is easy to grasp that the blue and red thirds of the spectrum add together to give a bluish pink and that the blue and yellow portions give green, there is nothing in the visual appearance of yellow to suggest that it is a mixture of red and green. This is, perhaps, not so surprising when one recalls that there is nothing in the visual appearance of white light itself to suggest that it is made up of a mixture of all the spectral colours—and that it can be synthesized by adding together the red, green and blue lights into which we have simplified the spectrum for the purposes of colour reproduction.

When the images on the three transparencies have been converted into the transparent complementary colour to the taking filter, it will be found that they can be superimposed in register on a white surface and that a satisfactory colour print is obtained. The whites of the print are now areas in which there is no colour deposit at all, and they are therefore as bright as the white paper support. Moreover, since by definition the toning colours used are those which absorb from white light the unwanted rays and transmit the rest, the colour range is obtained by such absorption. Thus, a primary red in a subtractive colour print is



SUBTRACTIVE PRINCIPLE. Section through a colour chart comprising superimposed pieces of pink, yellow and blue-green gelatin. Green, blue and red rays are absorbed by the pink, yellow and blue-green filters respectively, and it is upon this principle that subtractive prints are based

obtained by superimposing a yellow image (which absorbs blue) and a bluish pink image (absorbing green). Since the yellow removes the blue and the bluish pink removes the green, only the red rays of the spectrum will be reflected back to the eye.

The way in which the various colours are obtained in a subtractive print will be made clear by studying the diagram which represents a section through a colour chart made up by superimposing pieces of pink, yellow and blue-green gelatin.

Methods of Making Separation Negatives

All subtractive processes require three negatives of the subject exposed either simultaneously or in rapid succession through the three primary colour filters. It is the difficulty of obtaining these negatives which is the drawback to the subtractive processes.

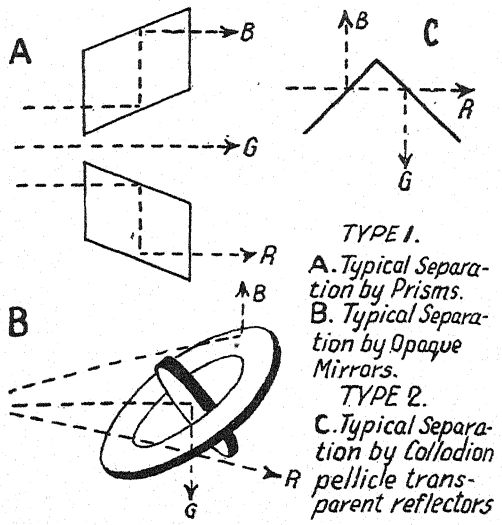
(a) **Using an Ordinary Camera.** The simplest method is to use an ordinary camera and expose the three plates in succession. This demands that even under ideal lighting conditions the subject remains still for at least twenty seconds. Nevertheless, the majority of separation sets are made in this manner, and when it has been necessary to keep the weight of the outfit to a minimum, excellent work has been done with the miniature cameras which use cinematograph film as negative material. An example of a Duxochrome print from negatives made in a Leica camera, with a total exposure time of 2½ secs. for the three negatives, is reproduced in the photo facing page 384.

(b) **Repeating Backs.** A repeating back on an ordinary camera is a dark-slide holding three panchromatic plates with a colour filter in front of each. The exposures are made by moving the back over by hand between each exposure, and the minimum time required for open-air work is approximately seven seconds under midsummer conditions (with an Autotype Back). The back can also be arranged to bring each plate into position by gravity fall.

The automatic repeating back (of Colour Photographs, Ltd.) is designed for use on studio cameras. It consists essentially of a dark-slide containing the three plates or cut films, with appropriate filters in front of each, together with a clockwork mechanism and liquid dash-pot controlling device so arranged that each plate in turn is brought in front of the exposure aperture and given a predetermined and controllable exposure. An average total exposure period of 1½ seconds at *f*5.6 is normally required in a studio lit with Kodak Unit Lighting totalling approximately 5,000 watts.

(c) **One-Exposure Cameras.** With one-exposure cameras all three plates are exposed

simultaneously, the light from the lens being divided up inside the camera by an arrangement of prisms or mirrors which divert appropriate fractions of the light to the three plates. There are two general methods of accomplishing this, illustrated diagrammatically below.



ONE-SHOT COLOUR CAMERAS. In one-exposure cameras the appropriate fractions of light are diverted to the three plates simultaneously. The methods commonly employed are shown here diagrammatically. A, separation by prisms ; B, separation by opaque mirrors ; C, separation by collodion pellicle transparent reflectors

The disadvantage of Type 1 is that, since different portions of the lens are used to form each image, stereo parallax is produced, and it is extremely difficult to make the final print register when, as in landscape, there is any appreciable depth of field.

In Type 2 transparent reflectors are used to divert some of the incident light on to two of the plates. In this case the whole of the lens is contributing to the formation of the image and stereo parallax is absent.

Unfortunately, cameras employing this system usually suffer from refraction and double reflection errors, and since the amount of light reflected from the glass surface depends upon the angle at which it strikes, there is a falling off in illumination across the plates. These difficulties can be minimized by using very thin collodion pellicles as reflectors (*see* further in page 227).

(d) **Separation Negatives from Additive Transparencies.** It is possible to consider an additive transparency as an original and photograph it three times through the three filters. Unfortunately, the prints eventually obtained are not so truthful or pleasing as straightforward separation sets. When an Autochrome is to be reproduced as a three-colour half-tone illustration this degradation is not necessarily important, since the reproduction process in any event involves extensive retouching of the printing blocks. Unfortunately, the need for retouching makes the truth of colour rendering entirely dependent upon the blockmaker's skill and knowledge of the original. Moreover, blockmaking is so costly that it is only justified when some thousands of prints in colour are required.

Regular mosaic processes lend themselves more readily to reproduction as subtractive prints, since the screen pattern is much less obtrusive. On the other hand, the high working speed of the modern screen plates and films is obtained by reducing the saturation—or colour density—of the screen elements to the minimum permissible. This minimum, although acceptable when the result is viewed additively, is below that required for satisfactory subtractive separation, and in consequence subtractive prints from additive colour pictures are unsatisfactory unless extensive colour retouching is given to the negatives or only broad, subdued colour effects are desired in the paper print.

(e) **Integral Tripack Processes.** It has frequently been proposed to obtain the three separation negatives necessary for subtractive printing by placing three appropriately colour-sensitized emulsions together and exposing the resulting tripack in an ordinary camera. In such tripacks the emulsion nearest the lens is not specially colour sensitized and records the blue rays by virtue of its inherent blue sensitivity. This emulsion is coated on a film base with a yellow backing which absorbs residual blue light but transmits the green and red rays. The middle film of the tripack is orthochromatic and, therefore, records the green, a magenta backing preventing unabsorbed green light but not the red rays from falling on the rear film or plate which, being red sensitive, records the red third of the spectrum. Such tripacks have achieved little popularity, since the rear image is appreciably diffused as a result of the scattering of the recorded light during its passage through the two front emulsions.

However, by coating all three emulsions in optical contact on one support so that the combined thickness of three layers is no more than that of ordinary roll-film, this lack of definition has been greatly reduced.

Such films are known as Integral Tripacks, and the simplest method of producing a colour photograph by their aid is to reverse the original negative to a positive as in the combined additive processes, using a technique for developing the positive, each layer being converted into a minus colour (*see* Kodachrome, New Agfa Process, pages 372–378).

Making Prints on Paper

If prints on paper are required, the transparency can be considered as an original and re-photographed by separation negatives. Here again, however, although there is no screen pattern to give a granular appearance to enlarged reproductions, the loss of saturation is again encountered and the separation negatives must either be colour retouched by hand or mechanically—as in the Eastman Masking Method—if satisfactory colour prints on paper are to be obtained.

In order to produce a colour print from separation negatives, it is necessary to make from them three transparencies in colours complementary to the original taking filters and superimpose these in register. These transparencies may be dye-toned silver positives (Dye-toning, *see* under that heading in the main alphabetical sequence), coloured gelatine relief images (Carbro, page 387 ; Duxochrome, page 392 ; Vivex, page 378), chemically-toned silver positives (Chromatone, page 396), or films of dye imbibed from gelatine positives on to a sheet of gelatine-coated paper (Pinatype, Eastman Wash-off Relief, pages 393, 394) or film (Technicolor, described under its own alphabetical heading). Paper printing processes are also considered in general by Mr. Chilton in pages 384–386.

Additive and Subtractive Methods Summarized

Every colour occurring in nature can be approximately matched by mixing together appropriate proportions of orange-red, yellow-green and blue-violet lights. In " additive " processes of colour photography the coloured result is obtained in this manner—we superimpose (projection lanterns) or add together (tiny filter elements side by side) appropriate portions of the three coloured lights, each consisting of one-third of the spectrum. In nature, substances are not coloured in this way, but instead they absorb or subtract certain portions of the visible spectrum of white light and reflect the remainder. It is this composite reflected portion which is the colour the eye records as the natural colour of the object, and this phenomenon is the basis of the " subtractive " processes.

An analogy may be drawn between additive and subtractive colour photography and modelling and sculpture. The modeller starts with an empty pedestal and adds clay to it in appropriate shapes until his model is complete ; whereas the sculptor starts with a block of stone and chips away unwanted material until the figure is complete. In just the same way, in additive colour photography we start with a dark screen and build up the picture by adding to it coloured light ; whereas in the subtractive processes we start off with white light represented by a sheet of white paper and remove from this light all the colours that are not actually required.

Colour Photography for the Professional

Finally, it is estimated that over 50 per cent. of colour advertising in the U.S.A. is based on colour photography, while in recent years the colour photographs on paper have formed approximately 15 per cent. of the total exhibits at the English exhibitions, " Photography in Commerce and Industry," organized by the Professional Photographers' Association.

Broadly speaking, from the point of view of the professional photographer, additive processes are chiefly of value for editorial illustration, while the more expensive and laborious subtractive processes are almost universally used as the basis for advertisements based on colour photography. The reason for this division will be clear after a study of the summarized advantages and disadvantages of each type (page 363).

Although a large number of processes are suitable for the amateur, the professional photographer in Europe relies almost entirely on Finlay and Dufaycolor for additive originals and the Vivex process for his subtractive prints. Kodachrome and the New Agfacolor are also used to a smaller extent.

SUMMARY OF TRANSPARENCY AND PAPER PRINT SYSTEMS

ADDITIVE PROCESSES (Dufaycolor, Finlay) and INTEGRAL TRIPACK SUBTRACTIVE PROCESSES (Kodachrome and Agfacolor) :

Advantages

(1) Truly instantaneous colour photographs are obtainable, exposures as short as 1/100 second under favourable conditions being possible.

(2) Cost of the colour original is relatively low, each individual shot costing in material a few shillings only.

(3) The time required from the moment of photography to the production of the finished transparency is a few hours at most in the case of additive processes, though Integral Tripack exposures must be sent to a processing station.

(4) An ordinary camera is used for making the photographs.

Disadvantages—(A) Common to all Transparency Systems

(1) Exposure latitude is small and the range of brightness which can be satisfactorily recorded is limited.

(2) Modifications in the form of art work are difficult to make and usually obvious. While any desired area can be brightened in colour by the application of dyestuff, such modifications are limited, for obvious reasons, to the lighter colours upon which the added dye will show up and alterations to expression, the fit of a dress, the elimination of unwanted detail, etc., are practically impossible.

Disadvantages—(B) Common to Additive Transparency Systems Only

(1) Although the accuracy of colour rendering in the original is higher than is obtainable by straightforward subtractive colour photography, this advantage is largely discounted by the inevitable loss of colour saturation which results when the printer makes his separation negatives from additive originals.

This loss can be made good on reasonably large areas of identical hue by fine etching the printing plates, and since photomechanical reproduction processes in any event involve extensive retouching, this drawback is not necessarily serious. It does mean, however, that subtle differences between various shades of green, for example, are lost.

The necessity for extensive colour retouching makes the truth of colour rendering almost entirely dependent upon the blockmaker's skill and knowledge of the original, and in many cases the final result is similar to that which is sometimes obtained by fine etching three monochrome blocks, using the transparency merely as a colour guide.

The additive screen plate is, from the photographer's point of view, a very convenient medium for the news picture in colour or for the object which is so perfect and so perfectly arranged that no modifications are required in the finished production. Whilst the reproduction of colour in newspapers, for example, remains at its present ingenuous level, the screen plate processes are probably good enough.

(2) The microscopic mosaic pattern upon which additive transparencies depend for their colour sometimes results in the introduction of a visible " moiré " pattern in the reproduction on paper, owing to the collision of the process engraving screen pattern with the mosaic pattern. Special methods, of which the crudest is to reproduce the subject slightly out of focus and, therefore, unsharp, are available for eliminating this defect, but the degree of enlargement to which additive colour pictures can be successfully taken is limited. This defect is not shown by Integral Tripack processes which can be enlarged up to eight times without obvious loss of definition.

Disadvantages—(C) Common to Integral Tripack Systems

(1) The accuracy of colour rendering is less than is obtainable by additive systems or by subtractive processes on paper where opportunity for colour retouching the negatives exists. The loss of saturation on copying mentioned under B (1) is also a serious drawback.

SUBTRACTIVE PROCESSES (Carbro, Vivex, Wash-off Relief) :

Advantages

(1) Since the commercial photographer's clients are usually print users whose aim is the mass production of a colour photograph on paper, there are obvious advantages in using as an original a paper print. Since this print is built up of pigments similar or identical to those which will be used by the printer, a clearer idea of the final result is obtainable.

(2) Generally speaking, considerably more latitude is available in exposure, though not to the same extent as in monochrome work.

(3) Shading during printing, retouching of the negatives and art work on the print can be carried out to modify in any desired manner the original colour photograph before this is handed over to the printer. Photographs of living models can be portrait and colour retouched to modify any desired portion of the colour original, ugly creases can be removed with body colour, wording can be added and the print can be cut up, and pasted into a layout if so desired ; whilst the printer's task is simplified to the reproduction of a continuous tone flat copy. The more subtle nuances of colour rendering—which distinguish a colour photograph from a hand-tinted monochrome—are more easily retained by using this familiar technique.

(4) Blockmaking charges can be reduced by grouping together colour photographs, and any number of prints—in any size from miniatures, 3 × 2 in., to the poster sizes, 60 × 40 in.—can be made from one set of negatives, to serve as an original for the process engraver.

(5) The original colour photograph is continuous tone and the blockmaker does not need to adopt special methods to eliminate the moiré effect mentioned under B (2).

Disadvantages

(1) The first cost is higher, since the process of producing colour prints on paper of a quality likely to appeal to the discriminating advertiser

is an exceedingly intricate one, which can only be carried out in plant especially equipped for the purpose.

(2) The time required is longer. For a first-class result five days are required from the time of photographing. This time can be shortened to 48 hours, and even to 12, if this is essential, but for a first quality result the full time is required, since much of this is occupied in making the detail corrections referred to and which account so largely for the popularity of subtractive systems.

(3) Expensive and frequently cumbersome cameras are required by the photographer. Many professional photographers hire equipment suited to the occasion, as and when required.

(4) Although instantaneous photographs are obtainable, the bulk of the subtractive prints used in industry are made with an exposure of 1½ to 2 seconds. Several one-shot cameras which permit of snapshots at speeds comparable with the transparency systems are available, but a good instrument is expensive.

COLOUR PHOTOGRAPHY: (2) ADDITIVE PROCESSES

The following series of articles deals with the chief additive processes employed in colour photography : that is to say, those processes in which the final coloured image is obtained by adding together appropriate proportions of the primary colours of the visible spectrum. They are arranged in order as follows :

(a) Lumière Ultra-Rapid Filmcolor (Autochrome)
by Alec J. Jones

(b) Dufaycolor
by George H. Sewell, A.R.P.S.

(c) Finlaycolor
by G. J. Field, of Finlay Colour (London), Ltd.

For the arrangement of the whole group of articles, see the main heading to the introductory section by Dr. D. A. Spencer in page 356. The present section is followed by four articles on the subtractive processes

THE first man to conceive the method by which the principles of the three-colour theory of colour vision could be applied to photography for the reproduction of natural colours was Clerk-Maxwell. In 1861 he demonstrated his theories by projecting through lanterns three photographs, one taken through a red medium, another through green and the third through a blue medium. When these photographs were projected, in the form of lantern slides, one on top of another (each lantern being provided with a filter of the colour used in taking the negative), a coloured picture was thrown on the screen. This was the first practical application of the " additive " process of colour photography, the theory of which is outlined in Dr. Spencer's introductory article.

In 1862 Louis Ducos de Hauron described, in a paper which was not published until 1897, an optical instrument called the " photochromoscope " for the additive mixture of three primary colour images, as well as outlining such modern processes as the mosaic screen, bipacks and even tripacks.

De Hauron in France and F. T. Ives in America did much valuable pioneer work in the field of additive colour photography, making three separate negatives through red, green and blue glass respectively.

The first practical attempt at a screen plate process, by using intermingled colour filters upon the plate itself and so obtaining the three colour records upon one plate, was made by John Joly in 1894. Alternate lines of red, green and blue-violet were machine ruled upon a glass plate. This was then placed in contact with a colour-sensitive plate and from the negative obtained a lantern slide was made. The ruled screen was then placed in register with the slide and a coloured picture projected.

This process did not succeed commercially, for the ruling was not fine enough and the plates then obtainable were not sufficiently sensitive, but a modification of this process appeared later as the Thames Colour Plate, and the principle was incorporated and improved upon in the Paget and Finlay processes. The first completely successful screen plate process was the Autochrome process invented by the French firm of Lumière, in which the surface of the glass was covered with a mosaic of dyed starch grains (*see* Lumière Filmcolor). This process gave direct transparencies in colour.

Several mosaic screen processes were afterwards perfected, all making use of the same general principles, but differing in the methods of constructing the filter screen. Dufaycolor, for instance (*see* page 368) makes use of a very fine transparent colour pattern consisting of alternating blue and green squares and red lines, the complete colour

pattern, known as the réseau, being reproduced five hundred times per inch. Incidentally, Dufaycolor is the only three-colour screen unit process which has been successfully used for cinematograph work.

In the Finlay process the colour mosaic and the photographic emulsion are on two separate glass plates, which are exposed face to face and in contact. In Kodacolor (now superseded by the subtractive process known as Kodachrome) the film base was embossed to give numerous microscopic lenses, which formed, in the plane of the emulsion, multiple images of a tricolour filter placed over the camera lens.

COLOUR PHOTOGRAPHY: LUMIERE FILMCOLOR

Evolved from the original Autochrome process, the Lumière Ultra-Rapid Filmcolor system, described here by Mr. Alec. J. Jones, is one of the most successful means of producing colour transparencies in use today

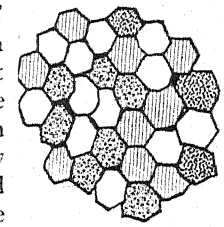
One of the earliest successful colour screen unit processes was that invented by the Lumière Company in the early part of this century. The surface of a glass plate was covered with minute starch grains dyed orange-red, green and blue, which were pressed into close contact with the glass, the interstices being filled with carbon black. This coating was then varnished and a layer of emulsion spread on top. These plates, first marketed about 1904 under the name of Autochrome, were widely used and gave very good results.

The same principle is employed in Lumière colour photography today, though technical progress has enabled many ameliorations to be carried out. The grain screen of Filmcolor, as the latest Lumière colour process is called, is infinitely finer than in the original Autochrome, and the emulsion is very much faster. In addition, the grain screen is now employed on a celluloid base, so that the process can be adapted for cut film and roll-films.

On a flexible celluloid support is spread an adhesive coating, which is covered with microscopic starch grains coloured orange-red, green and violet. This coating is rolled under great pressure until a mosaic coating of coloured particles, none of which exceeds 1/15,000-in. in diameter, is produced. Some 120 million of these grains would be needed in order to cover a half-plate negative.

The coating of coloured starch grains is then covered with a layer of waterproof varnish, and on top of this is spread the panchromatic emulsion.

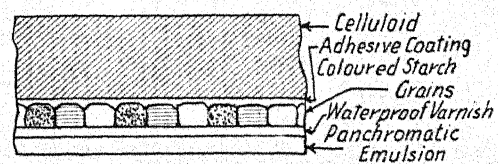
Lumière "Filmcolor" is placed in the camera with the celluloid—that is to say, the back of the film, facing the lens, in order that the light may pass through the coloured mosaic screen before reaching the emulsion.



STARCH GRAINS. These, coloured orange, green and violet, are shown highly magnified

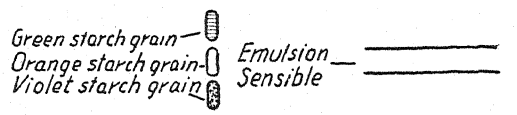
Now let us imagine that we are photographing a green object. In this case the green light rays pass readily enough through the green granules on to the sensitized emulsion, but are stopped by the orange-red and violet. Upon development of the negative it will be found that the emulsion behind the green grain turns black, but that it remains unaffected in other parts. When placed in the reversing bath the blackened silver behind the green grains is dissolved, leaving the emulsion transparent save where it has been protected by the orange-red and violet grains. A second development, which takes place in daylight or by strong artificial lighting, blackens the remaining emulsion, thereby covering up the orange-red and violet grains, so that when the film is viewed as a transparency, light can only pass through the green portion.

The green object we have photographed is therefore composed of an immense number of green dots, so microscopic in size and so close together that to the eye they present the appearance of an area of continuous colour. The granules of starch being stained with the three primary colours, orange-red, green and violet, Lumière "Filmcolor" can reproduce not only



FILMCOLOR. Section shows celluloid support, coloured starch grains and panchromatic emulsion. The starch grains are rolled under great pressure and amalgamated with an adhesive coating

these colours, but all their combinations ; by the mixture of these three primary colours, all the colours of the spectrum can be produced. So, in the varying final transparency of the coloured granules, the colours



REPRODUCING THE SCREEN. Example of a subject coloured green and its reproduction by Lumière Filmcolor. The green light rays pass through the green coloured grains to the emulsion, but are arrested by the orange and violet grains

of the object photographed are faithfully reproduced.

The older form of "Filmcolor" entailed the use of a special yellow filter over the lens, which made exposures rather long. The new Ultra-Rapid "Filmcolor" dispenses entirely with this filter, and consequently the speed is increased by about twelve times, and in good light instantaneous exposures can be made.

Exposure. The camera should be mounted on a rigid tripod, and it is advisable to use a long flexible shutter release to avoid camera shake, since the majority of subjects will need a "bulb" exposure.

Although Lumière "Filmcolor" is inserted into the camera with the back towards the lens, yet, owing to its extreme thinness, it is not necessary to reverse the ground glass focussing screen, as to all intents and purposes the film lies in the same plane as an ordinary negative.

As the rays of light have to pass through the mosaic screen before reaching the emulsion, exposure is slightly longer than for monochrome pictures, but the time is still comparatively short, owing to the rapidity of the emulsion. Simple exposure tables are supplied by the makers.

Development. Two solutions are used : a developer, which is used both for the first and second development, and a reversing bath, which is used for dissolving the silver image produced by the first development. The developer (which can also be obtained ready prepared) is made up as follows :

Metoquinone (Quinomet)	15 gms.	(½ oz.)
Anhydrous soda sulphite ..	100 gms.	(3½ ozs.)
Ammonia ·920 (22° Baumé)	38 cc.	(11 drs.)
Pot. bromide	10 gms.	(150 grs.)
Distilled water	1,000 cc.	(35 ozs.)

The metoquinone should be dissolved first in warm water (about 100° F.), then the sulphite should be added, and finally, but not until the solution is cold, the ammonia. For use, this stock solution is diluted with four times its bulk of water.

The reversal bath is prepared with :

Pot. permanganate	2 gms.	(30 grs.)
Sulphuric acid, 66°	10 cc.	(3 drs.)
Water	1,000 cc.	(35 ozs.)

This bath deteriorates if made up as a single solution and kept for any length of time. It is preferable, therefore, to make two solutions, dissolving the pot. permanganate in half the water (Solution I) and diluting the sulphuric acid with the other half (Solution II). They can then be mixed in equal parts when required for use.

An alternative reversal bath, which keeps better, can be made of :

Bichromate of potash	8 gms.	(120 grs.)
Sulphuric acid, 66°	12 cc.	(3½ drs.)
Water	1,000 cc.	(35 ozs.)

If this alternative bath is used, washing should be very thorough in order to rid the film of any yellow stain left by the bichromate.

Ultra-Rapid Lumière "Filmcolor" is sensitive to all colours and special care must be taken in dark-room lighting. The illumination advised by the makers of "Filmcolor" is obtained by using, in place of the usual safe light, a number of sheets of green Viripan paper placed between two sheets of the yellow. The light should be just strong enough to allow the time to be seen from a watch placed two feet from the lamp. The film should not be exposed to the direct rays.

First Development. The "Filmcolor" is immersed in the developer, the temperature of which should not exceed 65° F. (This applies to the temperature of all the baths and also the washing water.) The dish should be covered and gently rocked and a note made of the number of seconds which elapse before the first outlines of the image (disregarding the sky) appear. Development should be continued for ten times this period, keeping the dish covered. If the "Filmcolor" has been correctly exposed it may be developed by time, the period of development being 2¾ to 3 minutes at 60° F.

Never develop for less than two minutes or the finished transparency will be too dense, and never attempt to develop several films in the same dish.

Reversal. Rinse the film well and place in a dish containing about 100 cc. of

the reversal bath, and rock gently and continuously. A white light may now be turned on, or the operation may be finished in daylight. The image gradually becomes more transparent, and after about a minute and a half the image will be seen, on examination by transmitted light, to have cleared and the positive image will be plainly visible.

Second Development. Rinse the film for about thirty seconds if the pot. permanganate solution has been used, or for about four minutes in the case of the bichromate solution.

Then re-develop in the same solution as used for the first development, but this time the operation must be carried out either in full daylight or under a brilliant artificial light.

This second development takes from three to four minutes, at the end of which time the film is completely blackened.

Wash for four minutes and place to dry in a position as free from dust as possible, and in a current of air, so that drying is not unduly prolonged.

Intensification. If, after second development, the colours of the film lack vigour and are too weak by reason of over-exposure, *considerable* improvement can be made by intensification.

This may take place either at the time of development or at some later period.

For this intensification we strongly advise the use of the Lumière " Chrome-Intensifier." This consists of two solutions, A and B. The film is first treated with solution A, and then with solution B, which increases the density of the silver image ; this intensification continues as long as the film is left in the solution.

The colour values are much improved, become more vivid and more natural without either an increase in the grain or any undue augmentation of contrasts which would tend to make the images hard.

Directions for Use. Immerse the dry "Filmcolor" or "Lumicolor" in solution A for about one minute, then rinse for about a minute in running water. It is then to be treated in solution B for from 5 to 15 minutes, depending on the degree of intensification necessary. After a summary washing in water the process can be followed by inspection.

During intensification it is not necessary to rock the bath continually, only about every two or three minutes.

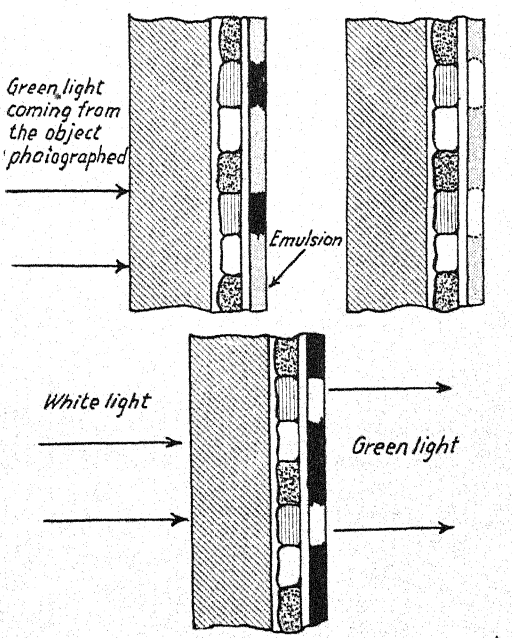
When the "Filmcolor" or "Lumicolor" is satisfactorily intensified, it must be washed for a few minutes in running water and then dried. If it has been made too dense, it is possible to reduce by a prolonged washing in running water.

With 125 cc. (4½ oz.) of each solution A and B, one may successfully treat 20 or 25 quarter-plate films. The intensifier is packed in bottles of 125 cc. (4½ oz.) and 250 cc. (9 oz.).

There is no remedy for *under*-exposures.

When dry the film should be varnished, as the emulsion is very delicate. Moreover, varnishing increases the transparence and beauty of the colours.

Ultra-rapid Lumière " Filmcolor " is made in flat films cut to the usual sizes. It can also be obtained, under the title Ultra-Rapid " Lumicolor," in roll-film form on spools 6 × 9 cm. and 6½ × 11 cm.



LUMIÈRE PROCESSING. Further stages in the production of a Lumière "Filmcolor" photograph. Above, the green light having passed to the emulsion, the latter is blackened behind the green grains when the first development is carried out. Centre, the blackened emu sion is then dissolved in the reversal bath. Below, the unexposed emulsion which has been unaffected by the first development and reversing bath is blackened by the second development. Violet and orange grains remain obscured and green grains are transparent

COLOUR PHOTOGRAPHY: DUFAYCOLOR PROCESS

The special features and principles embodied in the Dufaycolor process, which is widely used in both commercial and amateur photography, are here described by Mr. G. H. Sewell, A.R.P.S., of Dufay-Chromex, Ltd. Advice on the use, processing and after-treatment of Dufaycolor films is also given in this article

Dufaycolor is an additive process in which the visual primaries chosen are red, green and blue. These dyes are laid down on the cellulose acetate (safety film) base by first dyeing the whole surface of the film, printing on this with a resist in a series of fine parallel lines, bleaching and refilling the spaces between the lines with a second colour, removing the first set of resist lines and laying down a second set at right angles to the first, and repeating the bleaching and re-dyeing to add the last colour. This gives a functional pattern consisting of squares of two of the colours confined between a set of parallel lines of the final colour which, in the case of the commercial product, is red. This réseau is illustrated in detail in a colour plate facing page 357.

The material is made in film form only—it would be unduly costly to produce it on a rigid base—and is available in two forms or types. Type 2, as it is called, is issued in the form of flat film. Type 1 embraces every other packing including roll-film, 35-mm. film for miniature cameras, film pack and sub-standard cine film. There is also a third type, which is handled by both negative and positive methods, but this is still confined to the professional 35-mm. field and is not yet available to the general user.

The practical difference between the two types is one of colour balance. Type 1 can be used in daylight without any external filter. There is a range of filters available for artificial light work. Type 2 has a colour balance which necessitates the use of an external filter in daylight and an entirely different range of artificial light filters. This material tends to give a higher degree of colour accuracy owing to its greater "flexibility." Filters for other purposes or for other colour processes are not suitable for Dufaycolor; nor do the makers recommend the use of ultra-violet or similar haze-cutting filters. The speed of the material is about 400 H. & D. (English rating).

Viewing. It is more desirable with Dufaycolor than with other additive processes that the background against which it is viewed should be diffused in character. This is owing to the greater transparency of the material which does not, therefore, provide its own diffusion. Various viewing

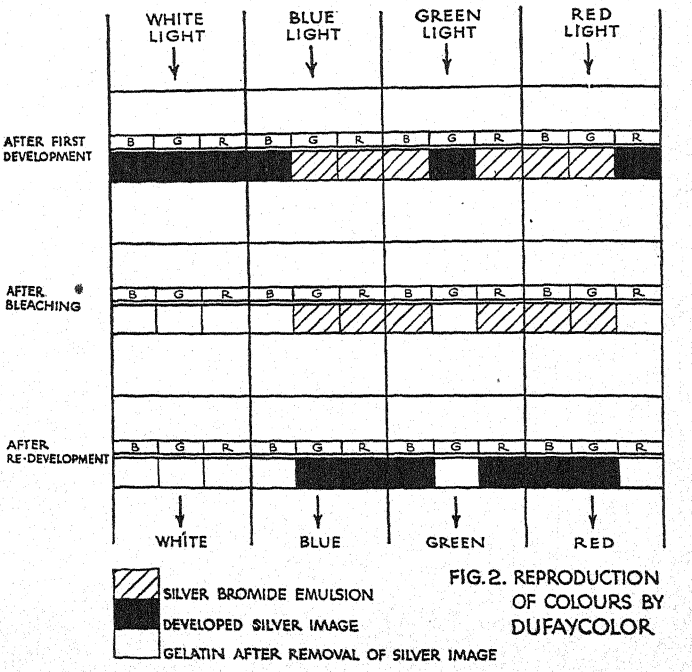


FIG. 2. REPRODUCTION OF COLOURS BY DUFAYCOLOR

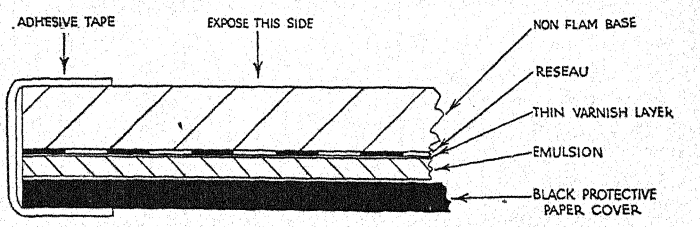


FIG. 1. CROSS SECTION THROUGH PIECE OF DUFAYCOLOR FILM

DUFAYCOLOR AND ITS ACTION. Fig. 1 (below). Sectioned view of film showing laminations of emulsion, varnish layer, réseau and non-inflammable base. Fig. 2 (above). How reproduction of colours is obtained by the action of the light rays on the filter elements and the subsequent processing

devices are available, including those issued by the makers of the material, but for daylight viewing a white cloud provides, perhaps, the best background.

Dufaycolor is particularly suitable for examination by projection, and thus for lantern slide work. A 500-watt lamp in an efficient lantern will give a 4 or 5 feet wide picture of adequate brilliancy with a normal transparency. A word of warning, however. Like all dye processes, Dufaycolor will fade if subjected too long to the combined action of heat and light, and the film base will also buckle under undue heat. The material should, therefore, never be projected in an ordinary lantern unless mounted between glass, and should be removed after about 30 to 45 seconds.

For sub-standard cine work a 500-watt lamp should provide adequate illumination. Light intensities which are excessive tend to make the pattern of the filter réseau unduly prominent on the screen. This rarely happens, however, since the pattern is extremely fine, consisting of over one million filter elements per square inch of the film material. This pattern is, therefore, never observable when projecting ordinary lantern slides, miniature camera pictures, or 35-mm. film.

Processing. The processing of Dufaycolor is not difficult, provided the makers' recommendations are most strictly adhered to, and adequate movement of the film in the solutions and adequate washing between solutions are maintained. The official formulae have been produced after several years of experiment by skilled technicians, and the newcomer is therefore recommended to adhere to these official formulae, at any rate at first.

The reversal processing method is employed. The film is first developed in a solution which contains either ammonia or potassium thiocyanate. The latter gives more brilliant results and is more stable than the ammonia, which loses strength by evaporation if kept. After washing, the negative image is bleached out in a permanganate-sulphuric acid bath, and is then cleared in potassium metabisulphite. A potassium bichromate bleach bath has been recommended, but tends to give stains. At this stage of the process white light can be turned on in the dark-room, but this should not be excessive, or degraded results will follow.

If at this point the high-lights of the picture are found to be covered with a white veil, owing to incorrect exposure or development, improvement may be effected by reducing in a 1 : 1,000 solution of potassium cyanide, until the high-lights appear *almost* clear, and then rinsing thoroughly.

After bleaching and washing, the film is exposed for a controlled period of time to a standard intensity of light, *e.g.*, four minutes at three feet from a 100-watt pearl lamp.

Final development can then take place in the first developer at full strength, or in any good M.Q. formula, and must be carried to completion.

Finally, after rinsing, the film should be fixed (although this is not necessary if the first developer is used for final development), thoroughly washed and dried.

High Temperatures. Processing and washing should be at 65° F. where possible. For temperatures of 75° or over use a suitable hardening bath *after* first development. It is also desirable to use a more diluted developing solution, increasing the development time in proportion to the degree of dilution.

Care should be taken to allow the solutions to cool before using, particularly in the case of the bleaching solution, which should not be used for at least an hour after mixing.

Latitude. The makers claim a wide range of latitude, bearing in mind the limitation of a colour material, and tests show that incorrect exposure is not accompanied by a great degree of colour distortion.

Over-exposure, of course, gives paler colours and lighter tones on the final positive, while under-exposure is identified by heavily saturated and dense shadows.

After-Treatment. Under-exposed transparencies can be improved by any of the normal intensification methods, or by use of the mercuric chloride-ammonium chloride formula recommended by the makers.

A physical development method is also recommended, but scrupulous cleanliness is essential to success.

Farmer's reducer can be used to treat over-exposed dense transparencies, but the

reduction of colour transparencies is not always attended with success.

Permanency. If the processing and after-treatment instructions are carefully followed, and washing is adequate, the results will be highly permanent. It is not desirable, however, that a dye transparency of any kind should be subjected to strong actinic light for long periods, otherwise fading will take place.

COLOUR PHOTOGRAPHY: THE FINLAY PROCESS

In this article, written by Mr. G. J. Field, of Finlay Colour (London), Ltd., a further variation of the additive system of colour photography is described. The many applications of the Finlay process are also dealt with

The Finlay process is a separate screen process applicable to plates and, as an ordinary plate camera will suffice, it quite easily lends itself to the amateur and professional alike, as extreme accuracy in colour rendering and great latitude in exposure place it among the leading colour processes.

This process, like all other colour processes, demands great efficiency in processing, and a few words on the actual working of the process will help to make all the steps clear.

The Finlay Company make screens of 175 lines to the inch, which, examined under a microscope, present a checkboard pattern of minute red, green, and blue squares, these actual squares being in the region of 1/350 of an inch in size. The screen as a whole presents the appearance of a piece of glass slightly reddish in colour with a film on one side in which the dyes are impregnated. As there is no sensitive emulsion on these screens they may be examined in any light, but care should be taken to see that the dyes are not faded through leaving them exposed to strong sunlight.

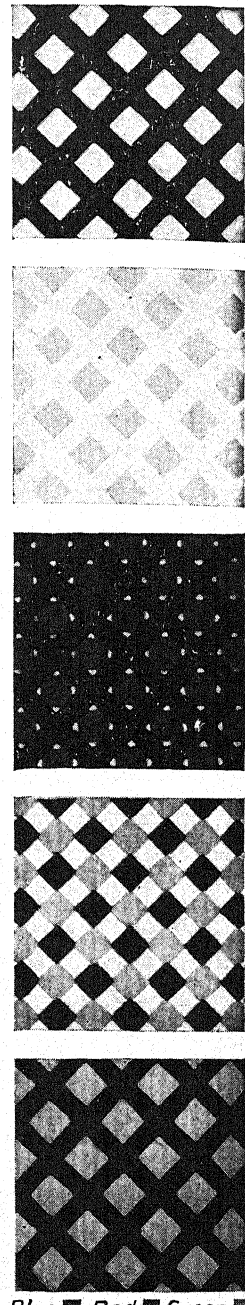
One of these screens is placed in a dark-slide in film-to-film contact with an Ilford Hypersensitive or Barnet Ultra-sensitive panchromatic plate, and with a compensating filter for the particular light in which the photograph is to be taken on the lens, an exposure is made. The exposed panchromatic plate is then taken apart from the screen and is developed and fixed in the ordinary manner.

After drying, a positive is made from this negative on a glass positive plate, and when this is dry it is again placed in film-to-film contact with a viewing screen. These are then rotated together in order to bring the screen on the positive in register with the screen on the viewing screen. This sounds rather complicated, but in actual practice is a simple operation which can be done at leisure.

The viewing screen and positive plate are then bound together at the edges with a gummed binding strip, and then present a picture in natural colours.

The processing is quite simple and can easily be attempted in the home dark-room, provided care is taken to see that the dark-room equipment is scrupulously clean.

It is quite simple to make unlimited duplications of any photograph, and black-and-white prints, and even enlargements, can be made from the colour negative.



FINLAY SCREEN. Manufacture of the Finlay screen involves seven operations The plate is first collodion coated, dyed green, albumen coated, and then exposed behind a black-lined screen. The green dots stand after the remainder is bleached out. Where the green dye has been effaced the area is dyed red and the plate is recoated with albumen. Next plate and black-lined screen are placed together, the green dots being obscured by the black lines where they cross, leaving red area alone exposed. The unhardened albumen is then washed off and the unprotected red area is bleached out. Finally, remainder of screen is dyed blue. Here are shown (1) printing screen ; (2) screen with green dots printed ; (3) screen with green dots and the area dyed red ; (4) screen with unprotected area of red bleached out ; (5) remainder of screen dyed blue



COLOUR PHOTOGRAPHY—AN EXAMPLE OF AN ADDITIVE PROCESS

This fine photograph of massed lupins taken at Lord Darnley's estate, Cobham Hall, Kent, is a very good example of what can be achieved by an additive colour photography process, the Finlay. The varying hues and delicate form of the lupins have been faithfully recorded and the colour rendering of the foliage, wall and sky is also good. The Finlay colour process is described in pages 370-371

Photo, Finlay Colour (London), Ltd.

To face page 370

CENTRAL ARCHAEOLOGICAL LIBRARY
New Delhi

Its speed enables colour pictures of moving subjects to be taken, no lengthy time exposure being necessary. Snaps at speeds up to 1/100 second are possible.

For the professional photographer its speed to half-watt lighting brings advertising and fashion photography well within reach of the studio camera. The ease with which black-and-white prints for layout purposes can be made from the actual colour negatives makes the cost of this process very low, and, since ordinary panchromatic plates are used, mistakes in exposure and movement of models, etc., entail no more additional cost than they would in black-and-white photography.

The ultimate use to which colour photography is applied by the professional photographer is colour printing. Colour photography has for some years been fighting to establish itself in the photographic world, and part of the reason for this was the lack of co-operation given by the blockmaker and the printer. This drawback no longer exists, and in most cases they will give real help to the photographer in order to obtain a really fine reproduction. The reproduction in either half-tone, photo-litho, gravure, etc., from the Finlay transparency requires the use of colour separation negatives. These can be made by the photographer himself by the use of panchromatic plates and the necessary tricolour filters, but the blockmaker will probably prefer to make his own, as he knows what he requires. The Finlay Company themselves also carry out this work.

The separations themselves play the most important part in reproduction. If the photographer himself wishes to make these, the utmost care must be taken to obtain the correct density and balance, as any mistakes made here can only be remedied by fine etching in the process works, which is a very costly procedure, and even then will not match the original.

This colour process also finds employment in pathology. Micro-slides photographed in colour form an inestimable guide to the pathologist, and many hospitals and clinics are making use of them in their daily research.

COLOUR PHOTOGRAPHY: (3) SUBTRACTIVE PROCESSES

The chief additive processes having been described, the principal subtractive processes are here dealt with in a similar manner. Whereas in the additive processes of colour photography the final image is obtained by adding coloured light to a dark screen, in the subtractive processes we start with white light and subtract from it those colours which are not required. The articles in this section are arranged as follows:

(d) Kodachrome
by T. L. J. Bentley, D.I.C., A.R.C.S., B.Sc., A.R.P.S., and E. A. Robins, F.R.P.S.

(e) New Agfacolor Process
by G. L. Harrison

(f) The Vivex Process
by F. W. Coppin, Works Manager, Colour Photographs, Ltd.

(g) Gasparcolor
by Imre Gaspar, of Gasparcolor, Ltd.

After this section follow a general article on Colour Print (Paper) Processes, and separate sections on Pigment, Imbibition and Toning Processes for Paper, which include descriptions of the Trichrome, Carbro, Duxochrome, Eastman Wash-off Relief, Chromatone and other Processes

As Dr. Spencer points out in his introductory articles, one of the great disadvantages inherent in the additive processes is that in practice they are limited to the production of transparencies. Colour photographs on paper, of sufficient luminosity to be of practical use, can only be obtained by the subtractive processes, and therefore this method is employed for colour pictures used in book illustration and advertising. (For various paper processes *see* Sections 4 to 7.)

Even when employed for the making of transparencies, especially when these are shown by projection, as in the case of lantern slides and cinematograph film, the subtractive process offers many advantages, the most important being a screen brightness comparable to that of ordinary black and white projection and an absence of screen pattern.

For this reason the cinematograph industry is concentrating more and more upon the subtractive processes, such as Kodachrome, Technicolor, and Gasparcolor, in the search for the perfect colour film. Only recently has the subtractive method come into its own in this particular field, and therefore it is all

the more remarkable that we should find the conception of a multi-layer emulsion recording in each layer a different part of the spectrum put forward by Louis Ducos du Hauron as long ago as 1895. In the words of Major Adrian Klein, in his book "Colour Photography," "rarely has such imaginative foresight been equalled in the history of invention."

Two-Colour & Three-Colour Processes. Until very recently all subtractive colour films were two-colour ; they included the early form of Technicolor, Colorcraft, Coloratura, Dascolour, Harriscolor, Magnacolor, Photocolor, and the earliest form of Kodacolor. But the two-colour process had great limitations owing to the total absence of genuine blues, yellows and yellow-greens, while the reds had always an unpleasant pinkish tinge. The two-colour process is, of course, a compromise and its colour range is limited.

It is unlikely that the two-colour processes will survive much longer now that the three-colour process has proved commercially practicable, although the fact that two-colour negatives can be obtained by bi-pack in a normal camera, whereas the three-colour negative needs a beam-splitting system of some form or other, may give a further lease of life to the best of the two-colour processes. On the other hand, further improvement of the optical design of three-colour cameras may provide a means of simplifying the present tricolour technique, as seen in the examples in page 227.

A three-colour process was essential if colour films were to cover a complete chromatic scale, but it was many years before the technical problems of three-colour subtractive films were overcome. The chief processes now in use are described in the following series of articles, save Technicolor, which is dealt with under its own heading in the alphabetical order of the work.

It is of interest to note that in two leading colour film processes—Kodachrome and Gasparcolor—the principle of the chemical sequence is opposed. In the former a tripack is used, the emulsions containing dye-forming agents by means of which the dye is formed where the silver is developed ; in Gasparcolor the dyes are already present in the triple layer of emulsion and are destroyed wherever the silver is developed.

KODACHROME PROCESS: CINE TRANSPARENCIES

Equally suitable for both still and cine work the Kodachrome colour process has very wide applications. Here Mr. T. L. J. Bentley, D.I.C., B.Sc., A.R.P.S., of Kodak, Ltd., explains the technical features of the process, while Mr. E. A. Robins, F.R.P.S., also of Kodak, Ltd., discusses Kodachrome from a practical point of view. *See* Colour Plate facing page 356

The Kodachrome process, which avoided the disadvantages of the intrusion of a filter pattern on the screen and the loss of light inherent in the additive synthesis of colour, replaced in 1936 the additive process of amateur colour cinematography known as Kodacolor, and thus made a subtractive colour cine process for amateur use a reality.

The principle is equally applicable to still colour photography, and in 1937 Kodachrome roll-films for 24 × 36 mm. cameras were introduced.

In the Kodachrome image there is no form of colour pattern whatever, the colour being present as a dye deposit which is even less granular than a black-and-white film image ; and since the white high-lights are represented on the film by clear film areas as free from colour or density as the high-lights of a black-and-white film, the screen brilliance is the same as in normal cine projection.

The Kodachrome process moreover makes colour cinematographic pictures as simple to the amateur as black-and-white cinematography. In its 16-mm. form it is a three-colour reversal process, employing a single film which first effects the colour separation automatically during the exposure in the camera, and then, on processing, produces the reversed image in natural colours for projection. The colour is present in the body of the processed film in the form of superimposed continuous dye images of almost grainless quality ; hence Kodachrome film can be projected with any 16-mm. projector, without special equipment.

In picture-taking the same simplicity is again evident, since Kodachrome film is normally exposed without a colour filter and with the lens at the same aperture as for Cine-Kodak panchromatic film. Only for the elimination of haze in distant landscapes is it desirable to make use of a colourless, haze-cutting filter which does not, however, affect

the exposure required. For artificial-light work also a correcting filter is required, unless Kodachrome Type A film is used.

The colour separation depends on the fact that the sensitive coating of Kodachrome film, which is scarcely thicker than the single coating of an ordinary film, consists of five exceedingly thin layers—three layers of emulsion with two intervening filtering layers of dyed gelatine. The total thickness of these five layers is only about 1/1000 inch. The upper layer is blue-sensitive and records the blue-component image, any residual blue rays being absorbed by the yellow-dyed gelatine layer beneath. The intermediate emulsion layer, to which only green and red rays penetrate, is an ortho. emulsion, which therefore records the green-component image. The bottom emulsion, to which only red rays penetrate, is red-sensitive and similarly records the red-component image.

In processing, which is effected by a series of continuous machines, the treatment is such as to produce in the three layers of the emulsion positive dye images in the so-called " minus " colours, the gradations of which represent the distribution of the corresponding primary colours in the subject ; *viz.* a yellow (minus blue) image in the blue-sensitive layer ; a magenta (minus green) image in the green-sensitive layer ; and a blue-green (minus red) image in the red-sensitive layer. This production of colour images depends on the use of dye-coupling developers (Fischer, 1912), the action of which is to develop exposed silver halide, forming simultaneously in the film a deposit of dye at the same point as the reduced silver. It has been found possible to discover coupler-developers of this kind which give dye images of the required colours and characteristics.

Stages in Processing .

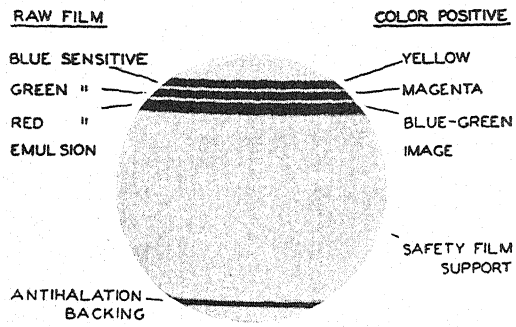
The first stage of processing is normal development and reversal of the silver image. The reversed film is then re-exposed and completely developed in a blue-green coupler-developer, which reduces the remaining silver halide grains and forms corresponding blue-green deposits in all three layers of emulsion. After drying, the film is then treated with a bleaching solution under such conditions that its action affects only the two upper emulsion layers ; in these it bleaches the dye and re-forms silver halide, leaving the blue-green colour in the bottom layer. Then follows a third development, with a magenta coupler-developer, which forms magenta deposits in the two upper layers. After drying again, the film is given a second bleaching treatment, which, however, is allowed only to affect the upper layer, leaving the magenta colour in the middle layer. A fourth development, in yellow coupler-developer, leaves the emulsion with dye images of different colour in each layer. In each layer, however, there is silver combined with the dye image, and the final treatment is therefore one which removes this silver entirely, leaving the dye images untouched. Kodachrome principles are shown in the Colour Plate facing page 357 and an example is given on the other side of the same Plate.—*T. L. J. BENTLEY, D.I.C., B.Sc., A.R.P.S.*

Practical Considerations

The basic idea of the Kodachrome process was invented by two young American musicians, Leopold Mannes and Leo Godowsky, Jr. Dr. Kenneth Mees, Director of Research to the Eastman Kodak Co. of U.S.A., placed at their disposal the resources of the world's largest photographic research laboratories ; but it was several years before the first reel of Kodachrome was exposed and shown by an amateur.

By that time (1935) one Kodachrome processing station had been established (at Rochester, U.S.A.) capable of handling 16-mm. amateur films only. At the time of writing there are eight stations—Rochester, N.Y., Chicago, Hollywood, London, Paris, Berlin, Osaka, and Melbourne—which also deal with the 8-mm. Kodachrome film. In addition, 35-mm. (still) Kodachrome film in two forms (one for 35-mm. miniature cameras, the other for Kodak "Bantam" cameras) is processed at Rochester, N.Y., London, Paris, and Berlin.

Kodachrome film in these three widths (8-mm. and 16-mm. for amateur cine films, and 35-mm. for still photography) is procurable in every country in the world except Soviet Russia and Italy. In addition, work was in progress to make the film available in single sheets of $3\frac{1}{4} \times 2\frac{1}{4}$ in., 4×5 in., and 5×7 in. sizes for the making of three and four-colour half-tone reproductions.



KODACHROME. The emulsion consists of three layers, each sensitized to one of the primary colours. A thin coating of clear gelatine separates adiacent layers

This does not mean that the ordinary amateur photographer can get, as yet, photographic colour prints made direct from Kodachrome transparencies : that, and also means of producing 8-, 16- and 35-mm. direct colour duplicates from the original colour film for projection in cine projectors are developments still in the experimental stage in the Kodak laboratories. Black-and-white duplicates and prints can, however, be made from Kodachrome films. A practical process called the Eastman Wash-Off Relief Process " (*see* page 394) is available, however, by which photographic colour prints can be obtained *indirectly* from Kodachrome transparencies.

The metallic silver grains of which all visible photographic images are normally made up are in Kodachrome film entirely eliminated during its treatment at the processing station, and the film, when returned to its owner ready for use, carries a pure translucent colour-image the dye-structure of which is microscopical and invisible to the human eye.

In practice, Kodachrome is found to possess a very high degree of resolution ; *i.e.* the colour pictures are extremely clear-cut, as well as clear. The colours are remarkably true to nature when the film is properly exposed.

Minimum and Exact Exposure

As explained earlier, neither in exposing nor in projecting Kodachrome film is any kind of colour-filter or other accessory attachment normally required. Consequently, Kodachrome can be used in any camera or cine camera which it fits, provided the apparatus is capable of giving an exposure of *not less* than 1/25 sec. in a still camera, or, in a cine camera, 1/32 sec.—the normal cine exposure—using stop *f*8 in both cases ; or any equivalent exposure, *e.g.* 1/10 sec. at *f*11 with a still camera, or half-speed with a cine camera at *f*11, etc.

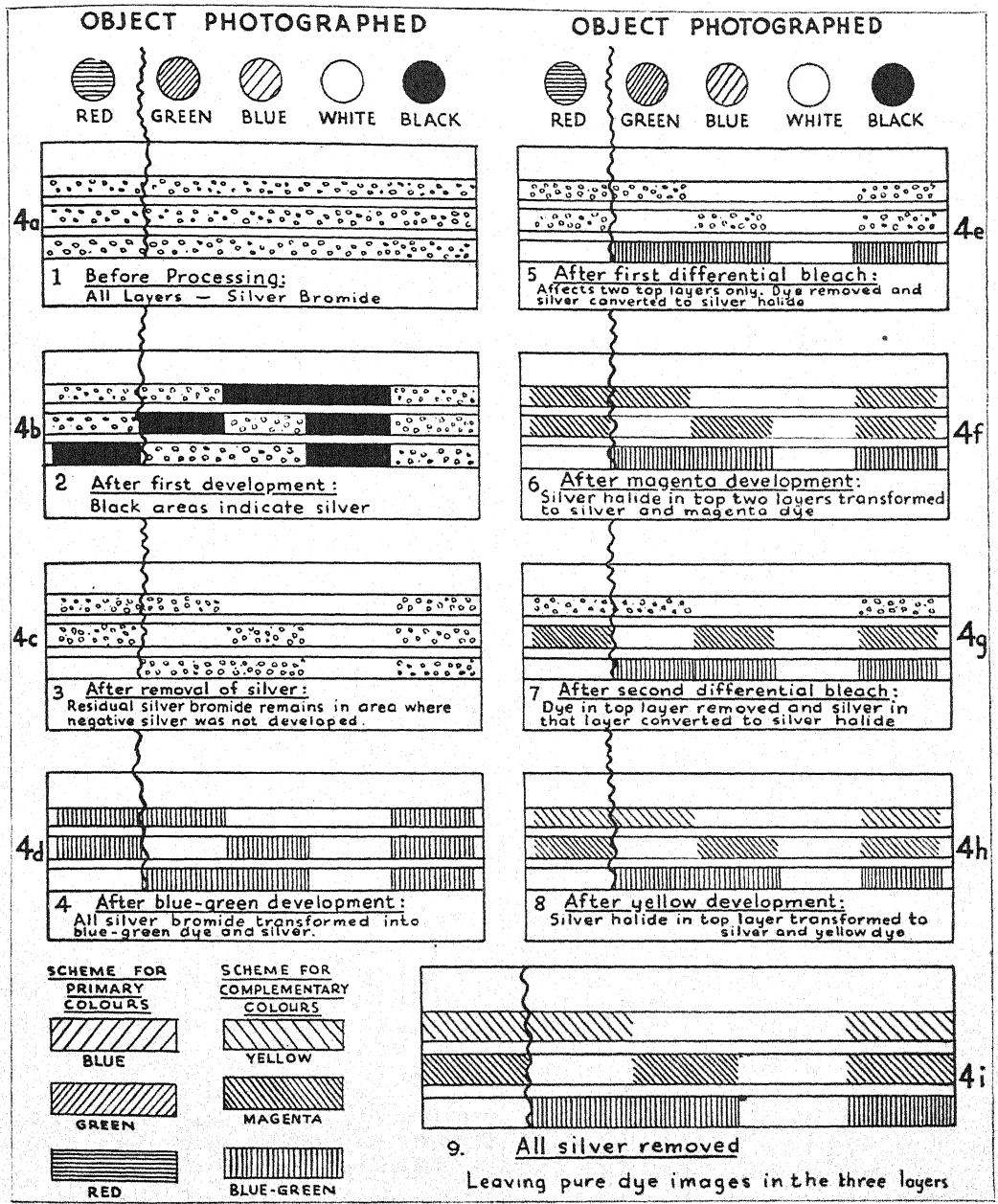
Kodachrome can be projected on to a home cine screen in any normal 16-mm. or 8-mm. projector in the usual way ; or, in its 35-mm. still form, viewed by daylight or projected by a suitable lantern, such as the " Kodaslide " projector, on to any ordinary magic-lantern screen. For the latter purpose the film pictures are usually made up as glass slides, size 2 × 2 in.

In exposing Kodachrome in either still or cine cameras, no special technique is indicated, except that the cinematographer should note that the latitude (*q.v.*) of Kodachrome film is less than that of the ordinary panchromatic black-and-white reversal cine films, and greater care must therefore be taken to get the exposures approximately right. Marked over-exposure results in a picture which will be too pale in tone : marked under-exposure results in tones which are too dark. Considerable errors in exposure may also give rise to imperfect colour balance. However, a variation of two stops on either side of the optimum will give entirely acceptable results with subjects not of extreme range.

Miniature camera users need no such warning when using 35-mm. Kodachrome, since they are already accustomed to the careful exposure technique which very small negatives naturally require.

An exposure table, enclosed with each carton of Kodachrome, makes the estimation of exposure a very simple matter. If use is made of an exposure meter, care must be taken that the film speed used is one officially recommended by the manufacturer for that particular meter. It must also be borne in mind that, owing to the smaller exposure latitude available, greater care must be taken in manipulating the meter.

Kodachrome film requires the same exposure as regular Cine-Kodak panchromatic film, or double the exposure (the next larger stop opening) for Cine-Kodak super-sensitive film ; while still Kodachrome would require about four times as much exposure as Kodak super-sensitive panchromatic roll-film. (This



PROCESSING THE KODACHROME. After exposure the film undergoes treatment in a series of continuous machines, and passes through various stages of development and bleaching as shown in the diagram above. In all, four coupler-developers are used and the film is bleached, leaving pure dye images in three layers. Processing is carried out only in the Kodak works and is not open to the amateur

comparison is only offered as a general indication of speed. In practice the Kodachrome exposure guide should always be consulted in estimating exposure.)

Obviously, therefore, Kodachrome is a high-speed film and can be used in comparatively poor lighting conditions, and even to take slow-motion colour pictures. It is hardly necessary to add that telephoto and wide-angle lenses can be used with Kodachrome in just the same way as with black-and-white films.

There are at present two types of Kodachrome ; the regular type and Kodachrome

" A," which is for use with artificial light. The type " A " film can, if necessary, be exposed in daylight also, provided a special filter is used. Similarly, another special filter is available which enables daylight type Kodachrome to be exposed in artificial light.

Kodachrome film " keeps " very satisfactorily *before exposure* and also *after processing;* but the period *after exposure* and *before processing* should be kept as short as possible. This rule was violently and successfully disregarded by the 1936 Mt. Everest Expedition, whose Kodachrome films survived slow transit through extremes of damp and heat before reaching the London processing station via Bombay and Air Mail, but though there was in fact a complete absence of colour fading, the manufacturers would not have guaranteed this.

In projecting a subtractive colour film such as Kodachrome far less intense illumination is required than for an additive colour film—any of the well-known 8-mm. or 16-mm. cine projectors, which are equipped with lamps of 110 or more watts, are perfectly competent.

In editing Kodachrome cine movies the normal cutting-and-splicing procedures are correct, and special coloured titles and title backgrounds are sold through the usual services available from photographic dealers and branch shops of Kodak, Ltd., who also supply the film in the current sizes and at current prices, which at the time of writing are in Gt. Britain : 8-mm. cine 25-feet reels (equals 100 feet, 16-mm. in screen time), 17s. ; 16-mm. cine 50 feet, 22s. 6d. ; 100 feet, 42s. ; also 100 feet with sound track, perforated one side only, 42s. ; 50-feet cassettes for Magazine Kodak, Simplex Pockette and Siemens Halske cine cameras, 24s. 6d. ; 35-mm. still, 18 exposures, 12s. 6d., These prices include processing and postage to any address in the U.K. and apply equally to Kodachrome (daylight) and Kodachrome " A " (artificial light).

The writer has no special Kodachrome " shooting " advice to give to amateurs except care in exposure and the maximum use of close-ups. " Flat-lighting," *i.e.* shooting with the light behind the camera, was at first favoured, but side and back lighting are just as practicable as with black-and-white films, and equally effective ; the truth is merely that " flat-lighting," which tends to produce uninteresting monochrome photographs, is effective in colour photographs because colour-contrast provides the desirable interest and solidity. Roughly speaking, all the rules for successful filming in black-and-white apply equally to Kodachrome filming, and similarly with miniature camera shooting on Kodachrome. For side lighting, double the normal exposure should be used.

E. A. ROBINS, F.R.P.S.

AGFACOLOR: THE 'NEW' FILM

Originally Agfacolor was a screen mosaic process (not dissimilar to the Lumière rice grain). The " New Agfacolor " film, as described here by Mr. G. L. Harrison, is a subtractive process of very high quality. An example is given in the Colour Plate facing p. 356

This is a subtractive process film, and at present only supplied in a 35-mm. strip, suitable for Leica or similar cameras ; the length of each strip is about five feet, giving 36 or over exposures, each picture measuring 36 by 24 mm. The size of the picture slide when mounted for projection is standard, two inches square, for the usual projector, or the strip can be wound through the projector in one piece.

As regards processing, up to 1937 the rights of this were reserved entirely to the Agfa processing laboratories, but it was expected that later home processing would be available. The cost of the film in England is 6s. per reel, which includes processing and return postage and a commentary on the results obtained.

Experience in taking over a thousand pictures in " New Agfacolor," mainly for experimental purposes and comparison with other processes, will no doubt be of assistance to new users of this film.

In the first place, it is essential to note that the speed of the film is 17 Scheiner, or about 190 H. & D., and the intelligent use of an exposure meter is necessary in order to obtain the correct colour renderings. The results given below were taken with a Leica, using the Summar *f*2 lens, and an Avo light meter. It was found that the film had rather more latitude than had been expected. Although the exposure can thus not be regarded as highly critical, definite

under- or over-exposure affects the result considerably. Grossly under-exposed pictures will give wonderful sky and cloud results and a light blue tint over the picture, whilst deep shadows will appear tinged with purple instead of being black.

Over-exposure leads to thin pictures with the colours weak and without much contrast; it will be seen, therefore, that subjects containing much contrast or shadowed foregrounds should be rather avoided, and the best subjects are those obtained in direct sunlight.

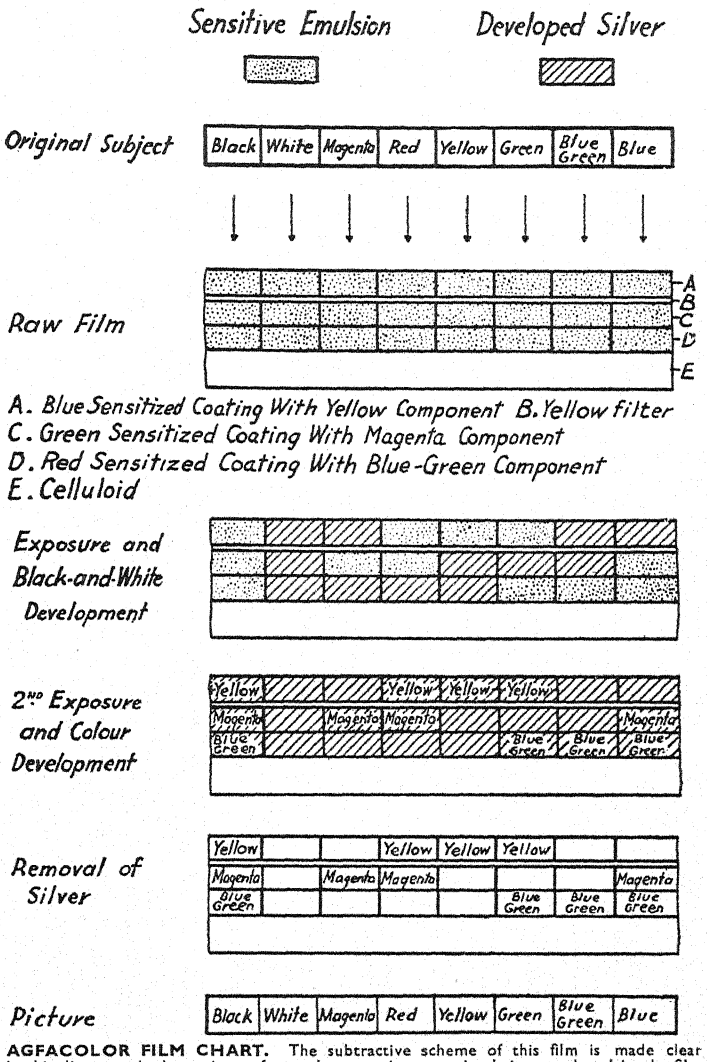
In ordinary "photographic" weather of fairly bright sunlight, an exposure of about 1/40 sec. at *f*3.5 to *f*4.5 gives excellent results and true colour values; little more is needed for the usual bright diffused daylight, but when the light is not good the exposure given should be from two to four times that shown by the light meter as being necessary.

Photos have been taken of a red sunset at *f*2, exposure being half a second, and repeated at two-minute intervals; the results have shown wonderful cloud effects, with the ground, trees, etc., as black silhouettes.

Forty-three pictures were taken in the Pergamon Museum at Berlin, exposure averages being ¾ second at *f*3.5; 38 of these were quite good, and in 32 the colours were faithful; no tripod is allowed in the museum, but the pictures were quite sharp.

At present Agfa are working on a film for work in artificial light and endeavouring to find the suitable filter; many pictures have been taken under ordinary lighting conditions in the home and elsewhere, and it is found that the warm tones come out particularly well, but the blues and greens are not rendered truly. An exposure of, say, eight seconds at *f*4 of a supper table under the usual 100-watt lamp will give the exact colours of the table "furnishings," etc., and all the warmer tones such as flesh colour, pink, yellow and brown are quite good, red being perfect.

During the Coronation celebrations a tripod was taken for the floodlighting of



AGFACOLOR FILM CHART. The subtractive scheme of this film is made clear in this diagram, the latent image for each separation negative being produced in the film at the time of exposure, since the film itself is coated with a yellow filter layer on top of colour sensitive emulsions. No special optical equipment or filters are required and any camera taking 35-mm. film can be used. See Colour Plate facing page 357 for a similar diagram in colour

Windsor Castle, and some 30 exposures made. The results showed little if any difference between 30 seconds and 1½ minutes exposure at *f*4.5 ; the yellow-tinged stone walls and architecture from the light of the flood-lamps made wonderful pictures with perfect definition. Exposure up to three minutes showed the Round Tower as a blazing mass of white light with every cranny clearly defined, with the flag still above ; and below the green gardens on the mound were well lit by the reflected light, in beautiful contrast, and with all details sharply outlined.

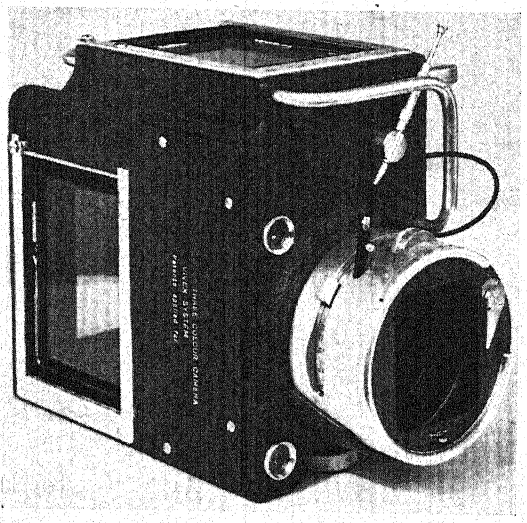
Street and Theatre Pictures

Ordinary street lighting at night, with neon signs, etc., requires about 10 seconds at *f*4.5, and for fireworks and similar displays good results can be obtained by the same exposure.

Many pictures were taken in a theatre, giving exposures at one second with an aperture of *f*2 ; from the front row of the circle the camera could be held quite still on the front rest kindly, but unknowingly, lent by the management. The majority turned out well, and exposures were made when there appeared a cessation of movement in the play, the final " curtain calls," when all the cast appear quite still at the front of the stage and in the full lighting, being the best. In these conditions, however, the warmer tones are correctly rendered, while the blue and green definitely require filters.

Pictures taken from an aeroplane are far more effective than in monochrome, lose their flatness, and objects show up by colour contrast ; in sunlight an exposure of about 1/40 second at *f*3.5 gives good results.

Projection on a screen of 6 feet by 4 can easily be obtained using a small projector of, say, 100 watts ; there is no reticulation or line grating effect, nor can any grain be found, as all the silver has been washed away in developing, only the dye stain being left as colour pictures.



ONE-SHOT, THREE-COLOUR CAMERA. This Vivex Camera requires one exposure to record the image on the three-colour separation negatives by means of colour filters, each one of which transmits one-third of the spectrum. The one-exposure camera eliminates the necessity of taking the same image three times with different films and plates, and it should be considered as complementary to the automatic repeating-back apparatus illustrated in page 379

VIVEX PROCESS PRINTS ON PAPER

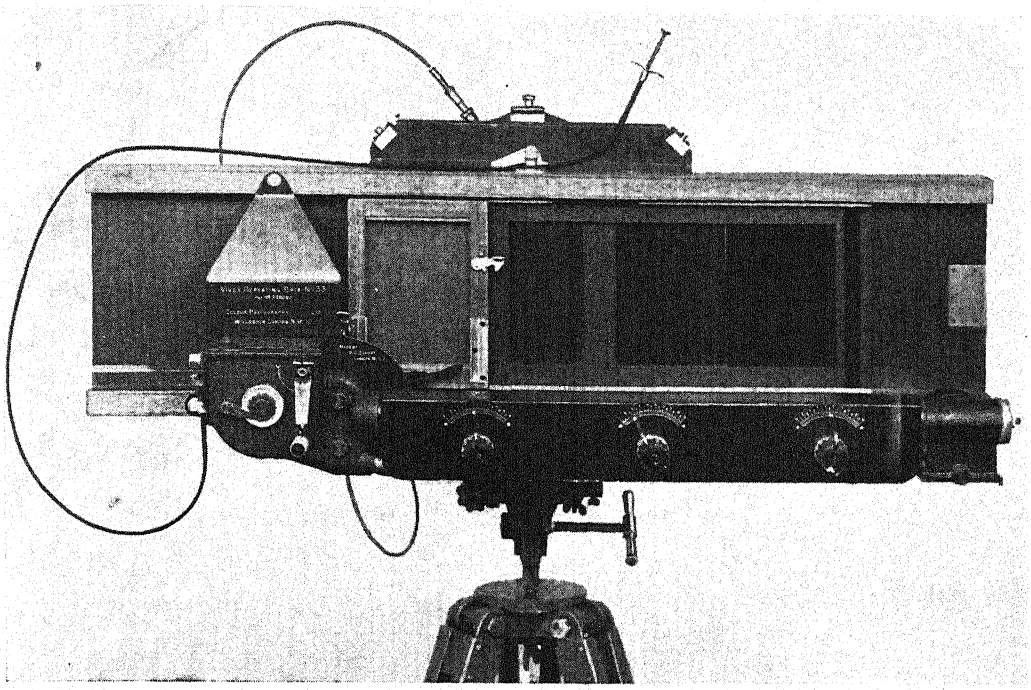
Satisfactory colour prints on paper are made possible by the Vivex process, as developed by Colour Photographs, Ltd., and described in the following article by F. W. Coppin, Works Manager of the Company. The process, similar in basis to Carbro, has been standardized so that results are no longer the result of experiment, but are assured. An example of the Vivex process is given in the colour plate facing page 117

Even the simplest of paper print processes requires more time and care than the average professional photographer can afford to allot, and it is practically impossible to produce commercially acceptable colour prints except by a considerable outlay on specialized plant worked by an experienced staff.

Professional photographers in England who require colour prints on paper therefore make use of the Vivex service of Colour Photographs, Ltd., of Willesden, which comprises a process for making colour prints from separation negatives in a factory properly equipped for that purpose.

The Vivex process resembles Carbro in its broad outlines, but the nature of the chemical and physical operations involved differ as radically from Carbro as Carbro does from the original Ozotype process of Manly on which it is based.

As in most colour processes, three-colour separation negatives are required and these are made through colour filters each of which transmits one-third of the spectrum. For still life work an ordinary camera is used,



VIVEX AUTOMATIC REPEATING BACK CAMERA. The repeating back apparatus takes three negatives in rapid succession, the exposures being automatically of correct duration. The process may require two to three seconds to complete, so that both camera and subject must be immovable

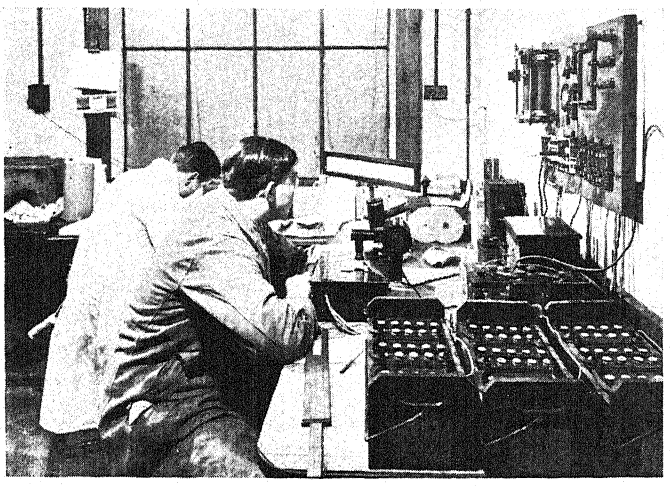
the three exposures being made through blue, green and red filters on separate panchromatic plates. The time required to expose and change the plates and filters is too long for subjects which include living models, and special apparatus has been designed to overcome this.

Vivex equipment includes the Vivex automatic repeating back—an apparatus designed for exposing three negatives one after the other in rapid succession. Means of automatically governing each exposure allow for the production of three properly balanced negatives under the most diverse lighting conditions in from two to three seconds.

The Vivex one-exposure camera has been designed for snapshot work in daylight or short bulb exposures in normal studio conditions. All known types of one-exposure camera have certain inevitable limitations (*e.g.* the necessity for using one lens for all types of work, and the absence of camera movements), and the Vivex camera is considered as a complement to, rather than a substitute for, the automatic repeating back. Together they are capable of covering all normal types of subject. After the negatives have been exposed and carefully developed, they are sent to the factory for printing.

The keynote of the factory is standardization of conditions—of times of exposure and development, of power of light, of temperature of solutions and workrooms, of atmospheric moisture, of electrical pressure. This standardization comes into play at the very first stage of the process. Sets of colour-separation negatives are first of all measured for density. This is done on a scale of neutral tones photographed at the same time as the subject. The use of such a scale is common among makers of negatives for colour printing, and if it is omitted the Company gets its information by making a trial print, a more expensive and less reliable method. This grey scale can conveniently be made from squares of bromide paper—black, mid-grey and white. In a perfect set of negatives this scale will be of identical density and contrast. In practice the general density will always vary slightly between each negative, but the contrast should be the same.

The grey scale densities are measured on a photo-electric cell photometer, the densities



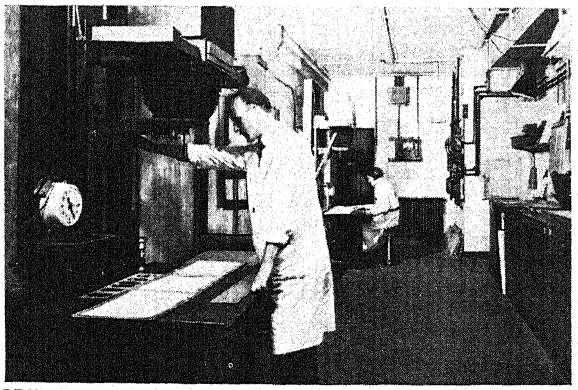
NEGATIVE MEASUREMENT. In the manufacture of Vivex prints, standardization is kept within fine limits. Here is the photometer apparatus used for measuring the density of the colour separation negatives

are plotted as curves and the curves show whether the negatives are in proper "balance" for colour printing. If not, one or more may be treated by a special system of controlled intensification.

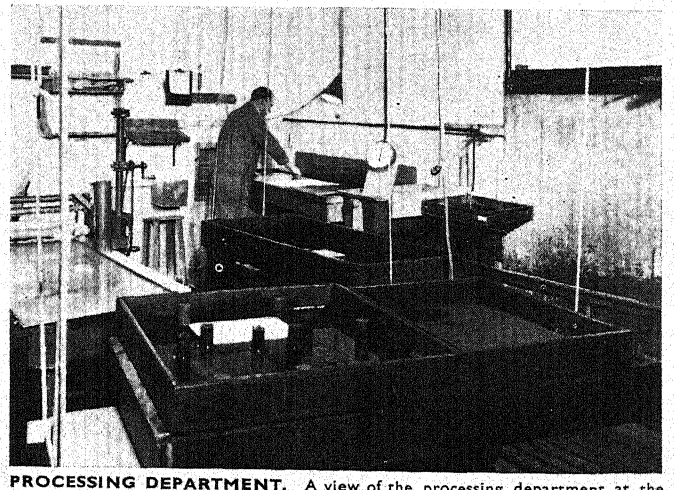
From each of these negatives a bromide print is made of the desired scale of enlargement or reduction printed to such a depth that the grey scale will be identical on each bromide print. The measured densities of the negatives enable the relative printing times to be calculated, but all factors involved in the production of the bromide print must be under accurate control. This means that a consistent light source must be available, and for this source mercury vapour is used, the current supply being controlled by an automatic induction regulator, while the light itself is continually measured by photo-electric cell plotting devices. Special methods are used to ensure accuracy of time of exposure, and the development of the print is carried out for an accurately controlled time in developer maintained at a constant temperature.

Special apparatus has been evolved for washing the bromide prints to ensure a complete removal of the fixing salts.

These bromide prints are then brought into contact, on a machine designed for this purpose, with sheets of pigmented gelatine (the so-called carbon tissue) which have been thoroughly soaked in a chemical solution. These gelatine tissues consist of soft gelatine containing primary coloured pigments. There is, therefore, yellow tissue, pink tissue and blue-green tissue. A chemical reaction is set up between the chemical contained in the



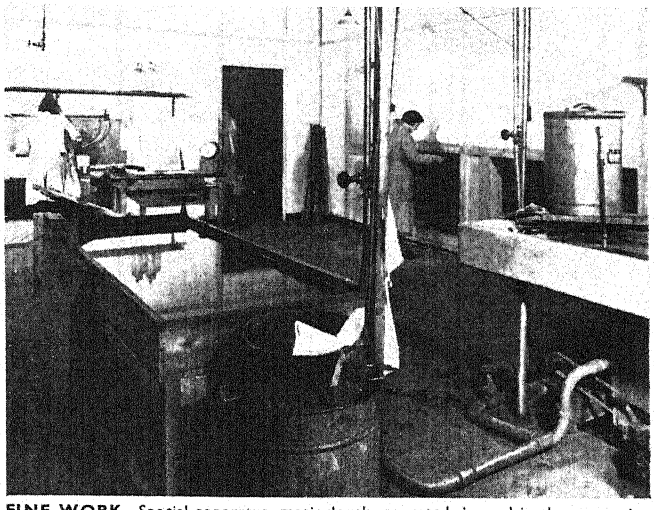
PRINTING PLANT. The department where the printing is carried out is equipped with apparatus which provides constant checking and control, so that the critical balance of the colours is uniform throughout



PROCESSING DEPARTMENT. A view of the processing department at the Vivex factory. Prints made by this process can be glossy or matt and can be assembled on wood and glass as well as on paper

carbon tissue and the black silver of the bromide print, and the composition of the sensitizing bath coupled with the method of application causes a hardening of the soft gelatine strictly proportional in depth to the amount of silver in the bromide print at every point in its area. The bromide print is, therefore, exactly duplicated in hardened gelatine containing colour.

The bromide print and the colour tissues are then stripped apart, when it is found that the bromide print has been completely bleached and a faint visible image produced in the pigmented gelatine as a result of the hardening action.



FINE WORK. Special apparatus, meticulously operated, is used in the processing departments, seen here, where the bromide prints pass through various stages towards completion

The room in which these operations are carried out is maintained automatically at a constant temperature, and special means are employed to maintain the sensitizing bath at an accurate concentration.

The surface of the pigmented gelatine on which the hardening has taken place is then covered with a specially prepared support which forms the carrier for the image during the subsequent operations, in which the unwanted pigment is removed and the colour images assembled in exact register on to the final support. Constant checking and control—most of which is automatic—ensures that the critical balance of the three colours is maintained throughout. The operations involved are all somewhat lengthy and complicated and are only possible with specially designed plant used under conditions where temperatures, humidities and light sources are under absolute control. It is a necessary consequence of the methods adopted that the amount of the three primary colours in any portion of the finished print is determined solely by the amount of silver in the parent bromide, and the inherent stability of the processes under these conditions of chemical and physical control is such that the balance of colour within the necessary limits is obtained, and runs of identical prints present no practical difficulty. Prints can be finished either matt or glossy and they are then assembled on paper, wood, ivory or glass.



FINAL STAGE. View of the studio where Vivex prints are assembled. Besides prints for advertisement illustrations, the Company produces facsimile reproductions of works of art

Meticulous register is obtained however large the print, definition being limited solely by the quality of the separation negatives. The hairs on a peach, the texture of fabrics, the brush marks of an oil painting, and the roughness of foliage can be needle sharp if required, though any degree of

diffusion necessary to soften hard outlines can be introduced if necessary.

While the majority of prints made by the Vivex Process are used as originals for magazine illustrations and advertisements of a variety of products, a considerable business is now done in Vivex facsimile reproductions of works of art.

The willingness of the artist to sign the completed prints testifies to the accuracy of the process.

GASPARCOLOR PROCESS FOR TRANSPARENCIES

One of the most advanced and efficient methods of photographing in natural colour is the Gasparcolor system, which is the invention of an Hungarian chemist. Its special features are here explained by Mr. Imre Gaspar

The requirements for a good process of colour photography are manifold, but nevertheless quite simple. The process should not be too elaborate to handle, should retain as far as possible all the standard operations used in black and white photographic practice, and, of course, give accurate reproduction of all the colours of the spectrum.

Again and again solutions have been suggested to this problem, some of them dating back as far as the middle of the 19th century. It is claimed that the Gasparcolor process, introduced about 1932, is a practical system providing a solution of the problem. In the course of an address to a meeting of the Royal Photographic Society on January 25th, 1935, one lecturer said :

" Dr. Bela Gaspar has given those of us who have spent most of our lives studying colour problems the material of our dreams—a three-colour, virtually grainless film, continuous in tone, which can be printed and processed by practically normal methods. No dyeing, no mordanting, no imbibition, no toning ; simply print and process."

It took twelve years of intensive research work to develop this process, and hundreds of patents have been taken out to secure its protection all over the world.

The Gasparcolor invention was the first to succeed in producing a colour film with three layers embodying dyes accurately sensitized to different regions of the spectrum. The Gasparcolor film offers a process by means of which a three-colour continuous-tone subtractive picture can be directly printed.

This film is so manufactured that three layers of coloured emulsions are carried on one common base. The layers are of silver bromide emulsions, which contain suitable transparent dyes in suspension. The dyes do not affect the sensitivity of the emulsions, and can be bleached out at a certain stage of the processing in direct proportion to the silver image already developed and fixed in the layer. It is necessary to have three colour separation negatives in order to print them on Gasparcolor film. These separation negatives can be made in a number of different ways. The important point is that each of the three separation negatives must record only a limited range of the spectrum.

The structure of the Gasparcolor film is as follows : the first layer is purple, the second yellow and the third layer blue-green.

The purple layer is sensitized to blue light only, the yellow layer underneath is sensitized also to red light, and the blue-green layer is again sensitive only to blue. By using coloured light in the printing operation it is possible to print the layers quite independently of one another.

How the Print is Made

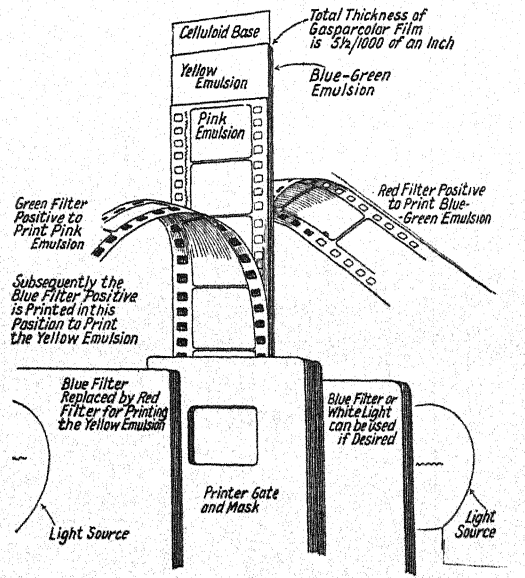
The printing is done by making so-called intermediate positives from the colour separation negatives.

The intermediate positive made from the green separation negative is used to print the purple layer. A blue light is used, and as the purple layer absorbs all blue light, the underlying yellow layer is not affected. In order to print the yellow layer, the intermediate positive obtained from the blue filter separation negative is used. The red light which is used in printing penetrates through the purple layer to the yellow layer without in any way affecting the purple layer, which is not sensitized to red light. Finally, a blue or white light is used to print the blue-green layer, and in this case the printing is done from the reverse side of the film. There are, of course, many possibilities of arranging and sensitizing coloured layers in different ways.

The processing machinery employed in the subsequent development of the film differs only slightly from the standard machinery

used for black and white work, apart from the greater number of baths employed. The printed film is first developed in a practically normal positive developer. It is then washed and fixed in the usual way. Then the film is placed in a reversal bath in which the dyes in the various layers are destroyed in direct proportion to the density of the silver developed. The film is then washed and enters a bath in which the silver image is bleached by a solution of copper sulphate, sodium chloride and hydrochloric acid. After a further wash the film is placed in a hypo bath to remove all the remaining silver. A final wash is applied before drying.

The resulting image is a pure dye image entirely free from grain and silver. The whites are pure transparent celluloid. Positives, and not the original negatives, must be used in the printing process, because the amount of dye destroyed is always in direct proportion to the silver present ; therefore the resulting dye image obtained must be the reverse of the silver image printed on the Gasparcolor film. The making of intermediate positives has also added advantages, in so far as the exposure balance can be more easily adjusted and any number of intermediate positives can be made, thus making the printing of copies of a film possible at any properly equipped laboratory anywhere, and so permitting the safe preservation of the original negatives for a long time.



METHOD OF PRINTING GASPARCOLOR FILM. The pink and blue-green emulsions are printed in one operation, subsequently the yellow emulsion is printed. After completion of the three printings the film is developed and reversed. The reversal process comp etely removes the silver, leaving a clear-coloured gelatine

Gasparcolor Process in Brief

In brief, the chief features of the Gasparcolor process may be described in the following way:

(1) It uses a three-colour film giving an excellent reproduction of the whole range of the spectrum employing a standardized manufactured film stock ; (2) it provides a photographically produced print and does not rely upon dyes, colour toning or chemical additions to produce colour. An almost standard black-and-white laboratory processing equipment can be employed without special machinery. At the conclusion of processing operations a film appears completely transparent and grainless ; and it has a continuous tone, three-colour image with a smooth range of gradations, which will bear very favourable comparison with the most satisfactory black and white positive print.

It does not require more light in the projector as the image is a pure transparent and grainless dye image, no silver being left in the emulsion and the prints are therefore less liable to scratches than the black-and-white film.

A black sound track on a transparent red background is used which gives normal results.

All these considerations make the process easily adaptable because any existing black-and-white processing laboratory can transform its machinery to process Gasparcolor film.

Naturally a great deal depends on the availability of a simple and efficient colour negative for use as a single negative in an absolutely standard camera.

On the basis of research work done by Gasparcolor chemists it is quite conceivable that a negative material fundamentally similar to the existing Gasparcolor film and eminently suitable as a negative colour film will soon be produced. Such an advance would influence the development and general adoption of colour films to a degree hitherto unforeseen.

:OLOUR PHOTOGRAPHY: (4) COLOUR PRINTS (PAPER)

L. V. Chilton, M.A., F.Inst.P., F.R.P.S.
Of Ilford, Ltd.

Following in logical sequence the series of articles dealing with colour photography in general and the various types of additive and subtractive processes involved, is this article on colour printing on paper. Sections 5-7 that follow deal with individual pigment, imbibition and toning paper printing processes

LL processes in this group are necessarily of the *subtractive* type, as a little thought will show. In all *additive* ocesses *see* Colour Plate (Fig. 1, facing ge 357) the picture is built up of adjacent l, green and blue coloured elements ore or less obscured by a black silver posit ; in the rendering of a pure white ere would be no silver deposit but only plain pattern of minute red, green and ue elements side by side. This would give paper a dingy grey, since each element ould reflect but one-third of the light.

olour Components

Colour prints on paper thus require the uperimposition in register of three coloured mage components *see* Colour Plate (Fig. 2, acing page 357) upon the white paper ase. The depth of colour in each component ranges from nothing up to some maximum, white being rendered by local absence of colour from all three components and black by the colours being at their greatest depth in all three. One image component is obtained by printing from each of the three colour-separation negatives, and the final print may involve the bodily assembly of three different emulsion layers on their supports, as in Chromatone ; or of the three " emulsion " layers alone, as in Carbro (or its commercial form, Vivex) ; or simply the *printing* of two of the images (*e.g.* in diffusible dyes) upon the third image contained in the base print (or of all three images on a plain white base), as in Pinatype.

As in all subtractive processes, the colours of the three print components must be complementary to the colours of the taking filters. Thus the print component from the red-separation negative has to be coloured *minus* red (or blue-green), and those from the green and the blue separation negatives have to be coloured *minus* green (or magenta) and *minus* blue (or yellow) respectively. For this reason the negatives are frequently called the blue-green (less correctly, " blue "), the magenta (less correctly, " red "), and the yellow, " printers. "

How are the colours introduced into the print components ? Evidently we may either use a sensitive material already uniformly coloured and remove the colouring matter that is not required in the picture, or we may start with uncoloured material and introduce colour in place of the silver of the developed image. The Carbon and related processes and Duxochrome are the only available processes using ready-coloured sensitive material.

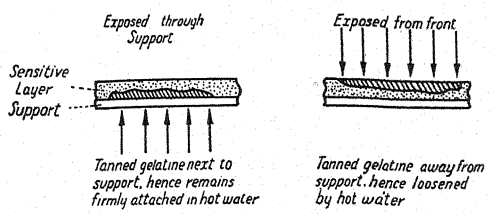
In all other present-day processes the colouring has to be introduced during the processing stages ; this is effected either by preparing relief images and dyeing them by " imbibition " (with subsequent transfer of dye) or else by converting black-and-white silver images to coloured images by (*a*) dye-mordanting or (*b*) chemical toning. Coloured images prepared by dye-mordanting are often too opaque, however, for this method to give real success in colour-print work. Practically all available colour-print processes are but combinations of these few basic operations. Before describing the more important types it would be well to say a few words about " relief images " and their production (*see also* Table in page 385).

Relief Images

In the Carbon process, gelatine containing ammonium or potassium dichromate is made insoluble by the action of light. In the Carbro process this same insolubilizing or tanning of gelatine is brought about by placing a dichromated pigment layer in contact with a wet bromide print ; wherever there is a silver image this becomes oxidized and the gelatine in its neighbourhood tanned by the reaction products. It is a simple step from this to take any black-and-white silver

image in a soft gelatine layer and bleach it in a bath containing dichromate, when the gelatine will be tanned wherever there is a silver image. If the layer is then washed in warm water the unaffected gelatine is dissolved away leaving a relief image in hardened gelatine, the thickness of which corresponds with the original silver image.

As a simple alternative the original image may be developed in a tanning developer such as pyrocatechin, thus avoiding the bleaching operation. Duxochrome employs ready-coloured material converted to a relief by a tanning developer, while the Eastman Wash-Off Relief process uses the tanning bleach method. In all relief processes it is essential to expose the material *through* a transparent support (usually celluloid) so that the image is located next to the base; otherwise it would wash off during the hot-water washing stage.



SUPPORT IN RELIEF PROCESSES. Diagram showing why in relief processes the material must be exposed through a transparent support with the image next to the base

Relief Processes. — Dyebro. This process, now of historic interest, employs dichromated gelatine tissue, but the relief is obtained following *contact* with a wet bromide print (as in Carbro) instead of by light-action.

Duxochrome uses special pre-coloured emulsions coated on a " stripping " celluloid base. With normal negatives the contact printing time for each component will be 5/15 sec. at three feet from a 40-watt lamp. All three may be developed together, using the proprietary developer, freshly made up in distilled water and of strength adjusted to suit the contrast of the negatives. The films are fixed in *plain* acid hypo, washed briefly in cold running water and then placed in hot water (120° F.) to dissolve away the untanned gelatine. Finally, the black silver image is removed in Farmer's reducer and the films thoroughly washed with warm water, thus leaving positive reliefs of coloured gelatine. These reliefs are next treated in a series of baths designed to render the colours absolutely permanent and, after washing and drying, not too drastically, are ready for stripping and transfer to a paper base.

Eastman Wash-Off Relief Process. This employs a special film not containing the final colouring matter, but bearing an emulsion (of speed suitable for contact or projection printing) containing a removable yellow dye which, by controlling the penetration of light, gives in the course of processing a well-graded relief image and therefore good printing quality, which is further improved by exposing through a Wratten violet filter No. 35. Equally exposed negatives require equal printing exposures. Development is carried out with the Eastman D-11 developer and the material is then fixed in a non-hardening fixing bath, *e.g.* Eastman F-24, followed by thorough washing in running water. The film is next bleached in an acid dichromate bath (Eastman R-10) and is transferred directly to warm water at 110° F., which dissolves away the unaffected gelatine and leaves a hardened relief corresponding to the parent silver image. The production of a relief by means of an acid bleach is the means employed by Technicolor to obtain their printing matrices, and supersedes the older methods of tanning with pyro developers. Technicolor is, in fact, very similar to Eastman Wash-Off, except that the tricolour dye images are finally supported on gelatinized celluloid instead of paper (*see* Technicolor). The Eastman relief process is considered in detail below.

Jos Pé Process. This utilizes reliefs produced with the aid of a tanning developer, the reliefs being dyed by imbibition and used as printing matrices much as in the Eastman process above (*see further* in page 394).

SURVEY OF PRINCIPAL RELIEF PROCESSES

Method of producing relief	Ready-coloured material	Uncoloured material dyed by imbibition
Light-action on dichromated gum or gelatine	Carbon	Pinatype
" Contact " action on dichromatd. gelatine	Carbro	Dyebro
Tanning devmt. of silver image	Duxochrome	Jos Pé
Tanning bleach of silver image	—	Eastman Wash-Off Relief

Chemical Toning Processes. Chromatone (1935). This is the only " all-toning " process so far available. The emulsions used are of speed suitable for projection printing and are coated on a thin collodion stripping base ; after developing, fixing, washing, bleaching and toning, the three-part images (stripped) are bodily assembled in register, face downwards, upon a gelatine-coated paper base. Special bleaching and toning solutions are supplied by the manufacturers and, in addition, three developer formulae are recommended, suitable respectively for soft, normal and vigorous negatives. *See* further in pages 396 and 397.

General Remarks. Negatives for colour-print work should normally be well balanced, such that neutral (grey) tints in the subject are rendered equally dark in all three negatives. So far as possible, therefore, a scale of black-and-white tones (*e.g.* stepped densities on a sheet of bromide paper) should always be included in the subject. Reproducibility of results in any colour-print process is obtainable only by the most rigid adherence to a set programme, such as that recommended by the various manufacturers ; there is no room for slipshod work, which will inevitably result in disappointment. The same precise working is necessary to obtain proper registration of the print components, since there is yet to be found a support which is absolutely non-stretching in the processing baths. In particular, if the three components have to be finally wetted down for assembly or transfer, all three must be allowed the same soaking times, or colour fringes will result.

It is not possible in a short article to give more than the general outlines of the processes, but detailed instructions are available from the manufacturers and in the books listed below. *See also* separate articles on Pigment, Imbibition, and Toning Processes in pages 386–398.

It may be well, however, to repeat that the majority of " new " colour print processes appearing from time to time are little more than combinations—with improved materials or minor changes in technique—of the basic processes surveyed in this article. Only in a few cases do they employ essentially new inventive steps. This may be of itself a disadvantage, but the opinion may be hazarded that the successful process of the future will require a real breakaway from convention. Books for further study are :

E. J. Wall: " Practical Colour Photography " (Boston: American Photographic Publishing Co., 1922).

F. R. Newens: " Colour Photography " (London: Blackie & Son).

C. E. Dunn: " Natural Colour Processes " (London: Chapman & Hall, 1936).

R. M. Fanstone: " Colour Photography " (London: Pitman, 1936).

COLOUR PHOTOGRAPHY: (5) PIGMENT PROCESSES

In the preceding article the general principles forming the basis of the various methods of making colour prints on paper are described. These processes are now dealt with in detail in a further series of articles which are arranged as follows :

(a) Trichrome Autotype Carbro Process, by B. Chambers, F.R.P.S.
(b) Duxochrome Process, by J. H. Coote

Followed by Sections 6 and 7, dealing with Imbibition and Toning Processes for Paper

IN the monochrome photographic printing processes known as Carbon and Carbro the beauty and permanence of the results are in essence due to transferred pigments which may be black or any one of a range of colours. In the processes considered in this section the principle is carried further. In its logical development the superimposition of three pigment colours transferred in correct register and order gives us Trichrome Carbro, a process which, though being far from the simplicity of this bare statement, has produced colour prints of great beauty and permanence. The related process well known as Vivex, a scientific and elaborate development of Carbro on different lines, is considered with the subtractive processes.

Another development on the parallel lines of pigment and wash-off relief uses sensitized pigment tissues. It is said to present no great difficulties, although the transferring operation is of critical importance for proper registration and to secure the necessary freedom from colour fringes. Good prints have been obtained using a one-shot colour camera, exposures 1/100 sec. (*see* Plate facing p. 384).

TRICHROME PRINTING: CARBRO PROCESS

The Trichrome system of producing coloured photographic prints is based on the Autotype Carbro process. Here Mr. B. Chambers, F.R.P.S., describes in detail the whole technique entailed in Trichrome printing, which is specially suitable for the amateur worker

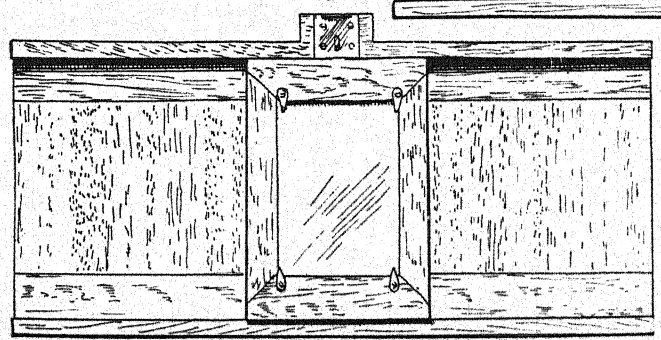
Among the various methods of producing photographs in natural colours, the Trichrome Carbro process is one which can readily be undertaken by the amateur. The final colour photograph may be either in the form of a transparency on glass, for projection, or on a paper base. The basis of the process is identical with that of the monochrome Carbro, which is fully described under the heading Carbro in pages 248 to 252.

The process may be summarized as follows : Three separate negatives of the object are made on panchromatic plates through tricolour filters, and Carbro prints are made from these on blue, red and yellow pigment papers on celluloid supports which are then superimposed in absolutely correct register on to a temporary support. Lastly, they are transferred from this on to a final support.

Making the Negatives. Three separate negatives of the object are made on panchromatic plates through tricolour filters : these being blue, green and red. The plates must all be of the same type, and should be taken from the same box, so that there is no difference in their characteristics. Neither camera nor object must move during the exposures, otherwise difficulty in registration will be encountered later. The exposures through the three filters vary and differ considerably according to whether daylight or artificial light is employed, but the filter factors are supplied by the plate makers in every box of plates. It should be noted very carefully that a mixture of daylight and artificial light must never under any circumstances be used or the results will be most unsatisfactory.

The filter may be placed in front of the lens, in which case focussing should be done before they are fitted ; or behind the lens, when focussing must be done with the filter in position. It is advisable, however, to make use of the Autotype Repeating Back, since in this inexpensive adjunct the colour filters are an integral part of the fitting and are automatically changed when the plate is moved. With this accessory only one long narrow plate is used (these special plates can be obtained from Messrs. Ilford, Ltd.), on which the three negatives are taken side by side (*see* Fig. 1).

In photographing " still life " or similar subjects it is useful for the beginner to place a graded wedge, which is supplied by the Autotype Company, near the object, but at one side of it so that it can be trimmed off the print without interfering with the actual composition. This wedge is a strip of bromide paper printed in squares of density varying from black at one end, through greys of diminishing strength, to white at the other.



TRICHROME CARBRO. Fig. 1. Autotype repeating back with the focussing screen shown in position. The back, which is easily fitted to any stand camera, greatly simplifies the operation of making three exactly registered negatives

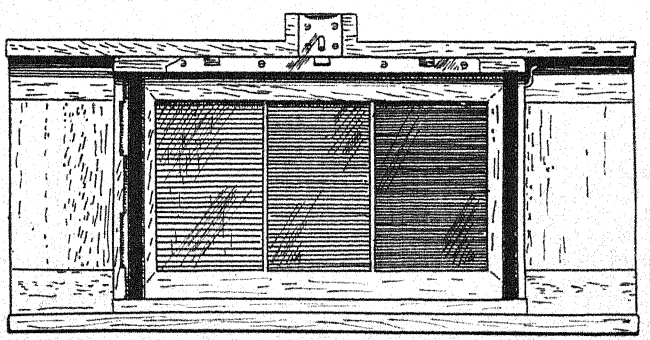


Fig. 2. Repeating back with the red, green and blue filters in position. When the plate is moved along the back the filters are automatically changed. The back with the dark slide in position is shown in page 388

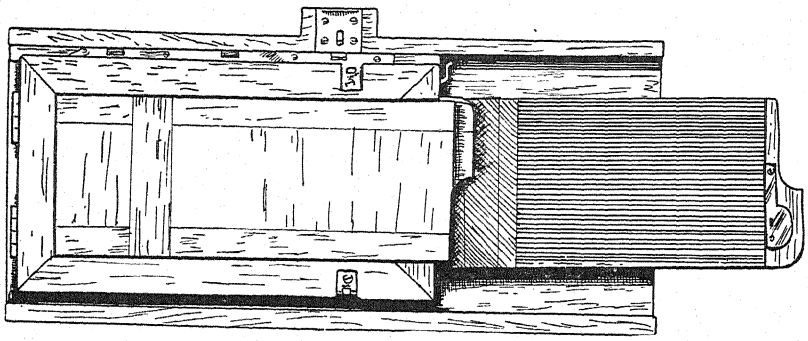


Fig. 3. Left: Repeating back with dark slide in position ready for making the third exposure

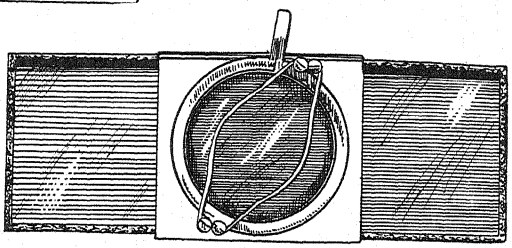


Fig. 4. Below: Filter holder containing the three-colour filters. This attachment is an alternative to the repeating back. It clips on to the lens mount

Developing the Negatives. This is carried out in the normal way, the time and temperature method being recommended. A soft negative, possessing full gradation, should be aimed at: dense or contrasty negatives should be avoided. When separate plates are used, they must be developed together in the same developer for the same length of time, and care must be taken to note through which filter each was taken.

Making the Bromide Prints. The bromide prints from the negatives are made with narrow white margins, and should receive correct exposure and full development. Grades of paper known as platino-matt or ordinary should be used, and should be marked on the back to show from which negative each was made.

It should be noted that papers which have received a supercoat to prevent stress marks are unsuitable, as this extra coating of gelatine prevents the full tanning action of the silver image of the bromide when it is placed in contact with the sensitized pigment paper.

If the bromide prints have been correctly made, the graded wedge previously mentioned should appear of the same strength and contrast in each print. When the bromides have been made, they can be used straight away or alternatively they can be dried and put away for future use.

Waxing the Celluloids. Carbro prints are made from the bromides and developed on celluloid supports. These should be larger than the bromides, leaving an inch or two to spare all round. They are first of all waxed to enable the Carbro images to leave them at the required time. A small piece of soft rag is moistened in petrol, rubbed on the special waxing compound, and this is spread over the celluloid, which is then very thoroughly polished with a soft cloth. It should be noted that only a very small quantity of wax is necessary. When polished, the celluloids are laid aside.

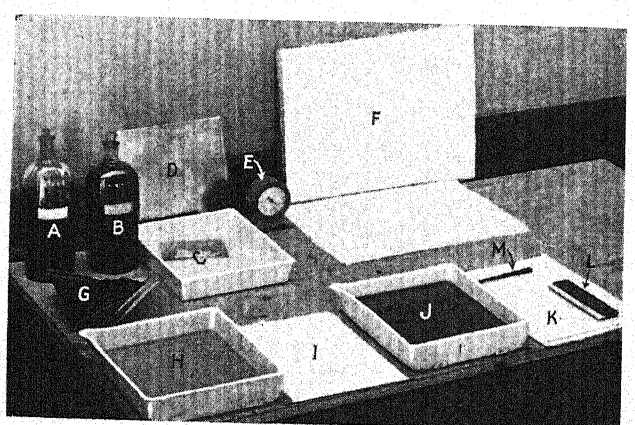


Fig. 5. Bench layout for Trichrome printing. A, Solution for bath No. 1; B, Solution for bath No. 2; C, Dish of water for soaking bromides; D, Celluloid sheets; E, Timing clock; F, Blotters; G, Tricolour tissues; H, Bath No.1; I, Glass for squeegeeing colour-sheet and bromide print; L, Squeegee; M, Knife

Two stock solutions known as A and B are required. Their formulae are as follows:

Stock Solution A

Potassium ferricyanide ..	1 oz.
Potassium bromide	1 oz.
Distilled water to	10 ozs.

Stock Solution B

Potassium bichromate ..	180 grs.
Chromic acid	40 grs.
Chrome alum	100 grs.
Distilled water to	10 ozs.

Working baths are then made up as follows:

(A) Stock solution "A," 1 part. Water, 4 parts.
(B) Stock solution "B," 1 part Distilled water, 4 parts.

Bath A can be used for a considerable time, but Bath B should be renewed for each set.

These solutions can be obtained, if desired, in the form of stock solutions from the Autotype Co., Ltd., of 59, New Oxford Street, London, W.C.1, who are the manufacturers of all the materials required for the process.

A quantity of the above solutions is poured out in two separate dishes and a piece of the blue pigment paper, which should be (and this applies to the other two colours) larger than the bromide print to allow an ample overlap all the way round, is then placed in Bath A. After about two minutes it is removed and placed face downwards on a sheet of glass and lightly squeegeed to remove surplus solution. It is then placed straight into Bath B and left therein for 25 seconds, care being taken to keep the pigment paper immersed in the solution, after which it is taken out and placed face downwards on to the appropriate bromide, which has previously been thoroughly soaked in cold clean water and laid face upwards on a piece of glass. The two are thoroughly squeegeed together and the piece of glass with the "sandwich" adhering laid on one side.

The red and yellow pigment papers are treated in a similar way and all three are then put aside for ten minutes.

At the same time as A and B baths are being prepared, a third dish should be got ready containing half methylated spirit and half water. Just enough to cover the pigment paper should be prepared, as this bath must only be used for the one batch. The preparation of this bath should not be deferred till it is required, as the mixture of spirit and water causes the temperature to rise, and it should not be used until it is cool.

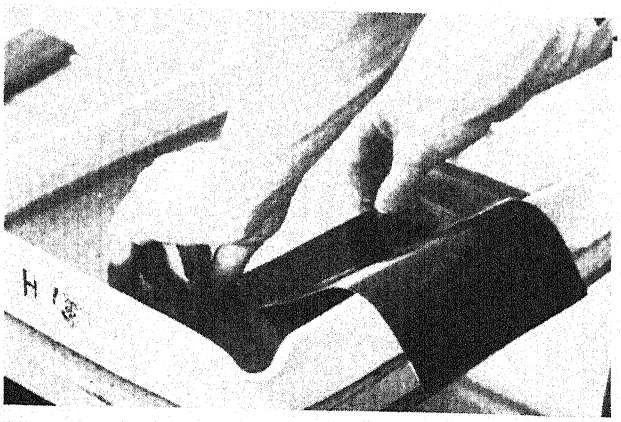


Fig. 6. Showing how the colour tissue is held at two corners and pushed under the surface of Bath No. B

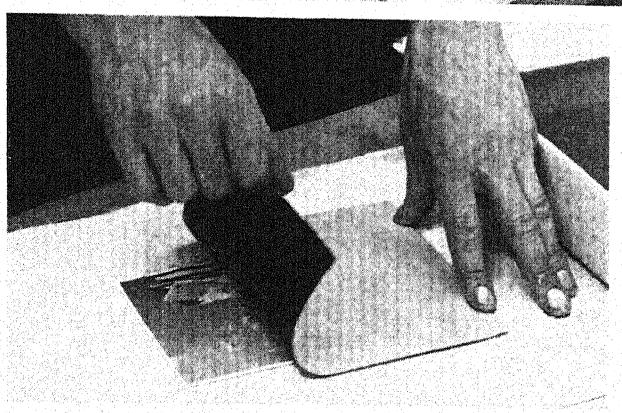


Fig. 7. First bromide print face up on glass with colour sheet being placed in position. The tissue must fall lightly on to the bromide print

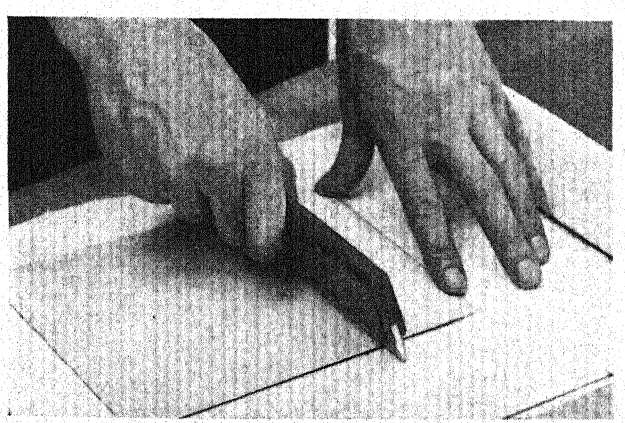


Fig. 8. Squeegee in use on sandwich. Movement is made firmly and evenly in all four directions. The glass is placed on one side afterwards, and left for 10-15 minutes

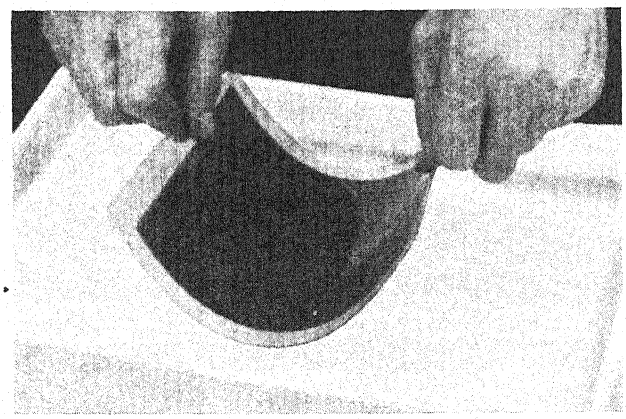


Fig. 9. How the celluloid bearing the colour sheet is immersed in hot water. With colour sheet beneath, it is bent slightly as shown and pressed beneath the surface, the paper backing coming into contact with the water first

Ordinary spirit as obtained at the oil shop is quite suitable.

After ten minutes the blue pigment paper is stripped from the bromide and immersed in the spirit bath for about 60 seconds and the bromide print put into a dish of cold water for subsequent attention. A sheet of celluloid with waxed surface uppermost is then placed on the sheet of glass and the blue pigment paper withdrawn from the spirit bath and squeegeed to it. A sheet of wax paper is laid on top and then they are placed between blotting boards.

The red and yellow pigment papers are similarly dealt with.

Developing the Carbro. After some ten minutes the blue pigment paper and celluloid are placed in a dish of hot water of about 95° F. with the pigment paper underneath, bending slightly so that the latter is on the outside of the curve (*see* Fig. 9). After a few seconds the celluloid is turned over so that the pigment paper is on top, and is again placed in the hot water. As soon as the pigment is observed oozing round the edges, the pigment paper is gently stripped from the celluloid under water, and the pigment paper thrown away (Fig. 10). Development of the Carbro image is completed by gently moving the celluloid under water until all the superfluous pigment is dissolved away, and this can be determined by holding the celluloid up on end from time to time and observing whether any pigment is running off the image. Similar treatment is given to the red and yellow pigment papers on their celluloids.

Should frilling up of the Carbro image from the celluloid be experienced, a small amount of chrome alum may be added to the developing water, but quite recently new non-frilling pigment papers have been introduced, and this trouble appears to have been entirely eliminated. The bromide prints,

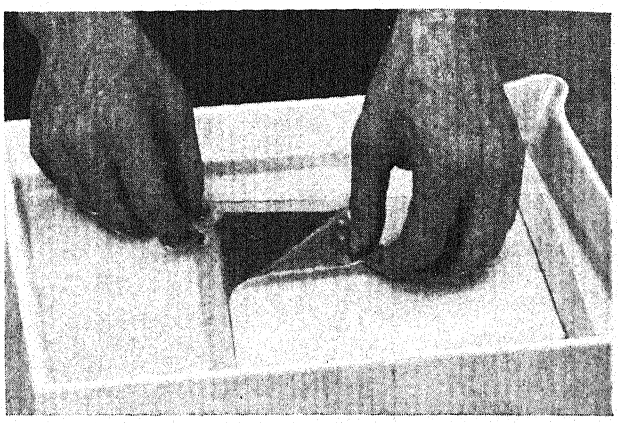


Fig. 10. When the pigment commences to ooze out at the edges the backing paper is stripped, keeping the celluloid beneath the water, as here shown

after having been thoroughly washed, are redeveloped and washed again, after which they are ready for making further Carbros. When the three Carbros have been developed on their celluloids, they are hung up to dry. They should be left where the greatest possible current of air can reach them, but at the same time as dust-free as possible.

Transferring to the Temporary Support. The next step is to transfer the three Carbros to the soluble temporary support paper, a piece of which is placed in a dish of cold water, prepared side downwards, and allowed to soak for a few minutes. (The prepared side can be determined by placing one corner between the teeth when the prepared side will stick.) The blue Carbro image is then slid beneath the paper and the two withdrawn from the water and squeegeed together and, after surplus moisture has been blotted off, are hung up to dry. When quite dry the temporary support paper is stripped

from the celluloid, when the blue image will be found to have left the celluloid and have been transferred to the temporary support. The celluloid is then ready for re-waxing and further use. The next step, and a most important one, is to remove the film of wax which has also been transferred to the temporary support. This is done by moistening a piece of soft rag in petrol and rubbing all over the surface of the support, and wiping off with a clean piece of rag. To make certain that this operation is complete, it is as well to repeat it a second time.

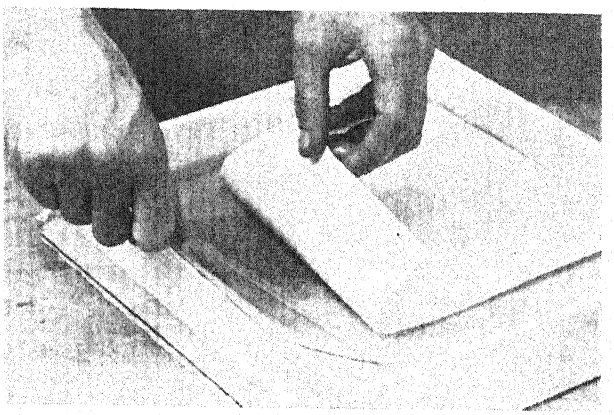


Fig. 11. Temporary support with Carbro image and celluloid bearing the next colour being placed together for rough registration. The celluloid is slid underneath as shown

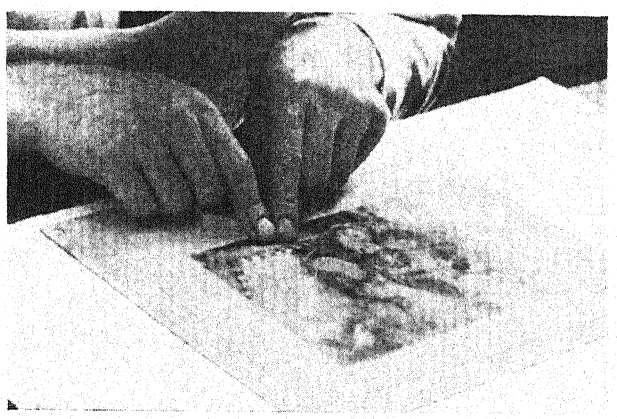


Fig. 12. The sandwich is placed on blotting-paper, celluloid uppermost, and moved into exact register. Local correction is effected with finger-tips

Transferring the Red Carbro. The soluble temporary support is again placed in the dish of water, allowed to soak for a few minutes and the red image slid underneath and withdrawn as before. After this it is roughly placed into register and given a light stroke with the squeegee. This "sandwich" is then placed on a piece of white paper, or held up to a strong light and the two images slid about until exact register is obtained, when they are squeegeed together in perfect contact, care being taken to see that no movement takes place while doing this (Fig 8.)

Should the red image refuse to slide on the blue, or movement take place during the last squeegeeing, it is permissible to strip the two apart, place in water and start again. Provided reasonable care is exercised, these images will stand quite a lot of "teasing."

When the red image has been superimposed on the blue, these are hung up to dry and stripped apart as before, when the blue image with red superimposed will have been transferred to the temporary support, and after again carefully removing the wax, the yellow image is treated in a like manner.

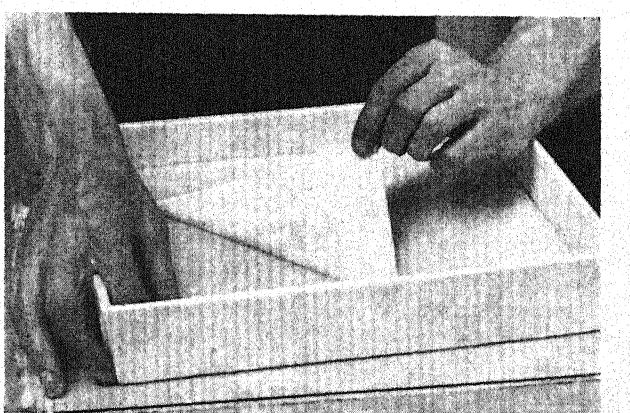


Fig. 13. The transfer to final paper. The three combined images, after being stripped from the celluloids, are squeegeed into contact with the transfer paper. After immersion in warm water the two are gently pulled apart, as shown, the coloured photograph being transferred to the final support

Transferring to the Final Support Paper. When the three combined images have been stripped from the last celluloid, the wax is again removed and the temporary support again soaked in water for not more

than one minute, when it is laid face downwards on to the prepared side of a piece of single transfer paper which has been previously soaked in water for ten minutes and the two are squeegeed together. They are placed between blotting boards for about 20 to 30 minutes, then withdrawn and placed in a dish of warm water at about 105° F. After a few moments the soluble support is stripped off under water

A coating of soluble gelatine, though invisible, is left on the surface of the print, which should be very gently splashed to remove it. It will now be seen that the three superimposed images have left the soluble temporary support, which is of no further use, and have been transferred to the final support. This is now hung up to dry.

Trichrome Transparencies. These are made in exactly the same way as described above, but instead of transferring to a final support paper are transferred to glass, which can be obtained in all sizes. All three images for a transparency should be decidedly darker than those produced for a print. The transparency when dry should be bound to a piece of white opal, or ground glass.

Lantern Slides. With the discovery of an exceptionally transparent yellow, it is now possible to produce three-colour lantern slides by the Trichrome Carbro process, and slides produced by this method possess definite advantages over most screen plates. They are more transparent and can be projected with a comparatively low power illuminant.

DUXOCHROME COLOUR: A PRINT PROCESS

Glossy or matt prints in colour are fairly easily obtainable from special Duxochrome colour films. The Duxochrome films have the great advantage of allowing printing to be done from separation negatives either by contact or by projection. An example is seen in the Colour Plate facing page 393

The Duxochrome paper printing process of Messrs. Johannes Herzog & Co., of Bremen, possesses certain similarities relating it to both the Carbro and Wash-off Relief processes. The Duxochrome colour printing films are the " idea " in the process ; they are red, blue and yellow as tricolour carbon tissues, but are also sensitized as are Wash-off Relief films. This latter factor makes it possible to print from separation negatives.

In addition to depending upon pigments, Duxochrome is a " relief " process ; in other words, it depends upon differing depths of gelatine to form varying gradations of the three complementary colours. As with all printing methods, a good set of separation negatives is a *sine qua non.*

The Duxochrome film packets are opened in red light as for bromide paper, and testing for exposure is carried out with the strips supplied. The colours of the films are easily distinguishable, the blue appearing almost black. The films must be exposed (to their respective negatives) through the back or celluloid side, and the speed is similar to that of slow bromide, but all the colours are not equal in sensitivity, as naturally the red and especially the yellow dyes have a filtering effect upon the blue sensitive emulsions. The films should not be developed visually.

Development is carried out only in the developer supplied, which differentially hardens or tans gelatine in the region of a developed silver image, as do all developers containing pyro or pyrocatechin.

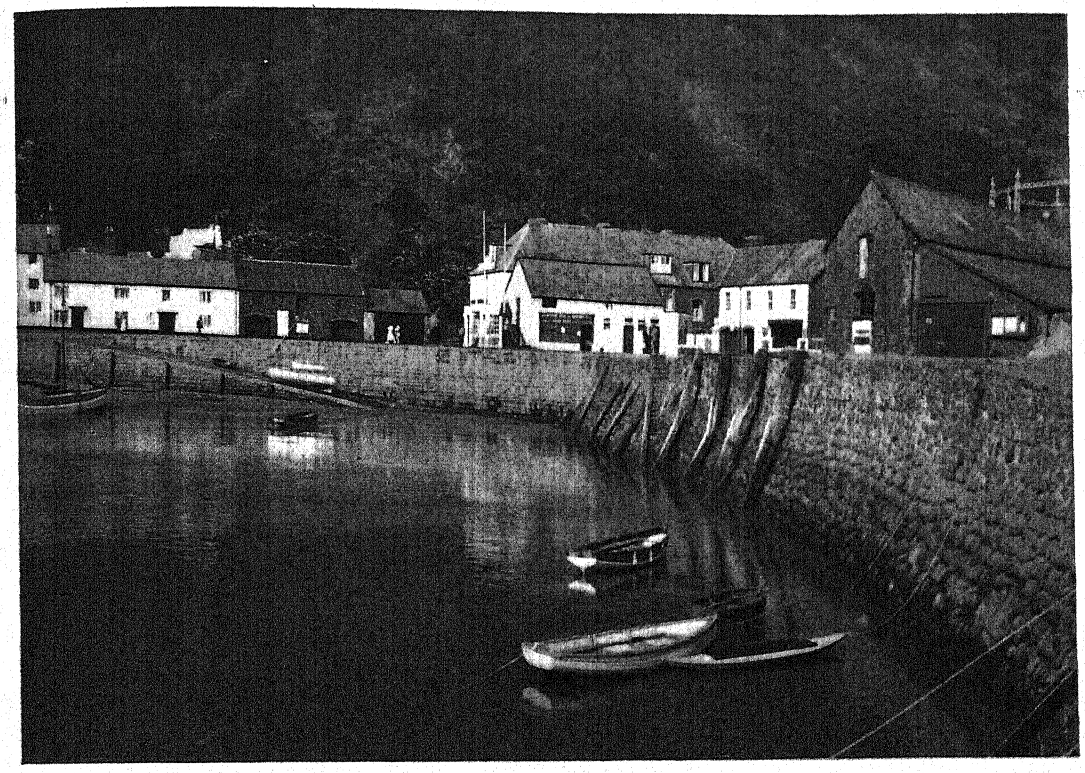
If the separation negatives are of normal contrast, five minutes development at 65° F. will be correct. When printing from very contrasty negatives, however, it is advisable to develop the well-exposed films for only three minutes at 78° F. Further dilution of the developer will also contribute towards additional softness. From very soft separations only half the water should be added to the developer stock and development prolonged to eight minutes. The sets of three films should be developed at the same time and must be frequently moved in the developer. The once used developer must be thrown away and fresh used every time.

After development films are transferred to a *non-hardening* acid fixing bath, and when fixing is complete all subsequent work may proceed in daylight.

Fixing Bath

Hypo	2 ozs.
Potassium metabisulphite	¼ oz.
Water	4 ozs.

The films are next rinsed in water for three minutes, and then placed separately in water at about 120° F. The colour emulsion not hardened by the tanning developer will begin to melt and wash away as in the Carbon or Carbro processes, with the



'MINEHEAD HARBOUR'—FROM A DUFAYCOLOR TRANSPARENCY

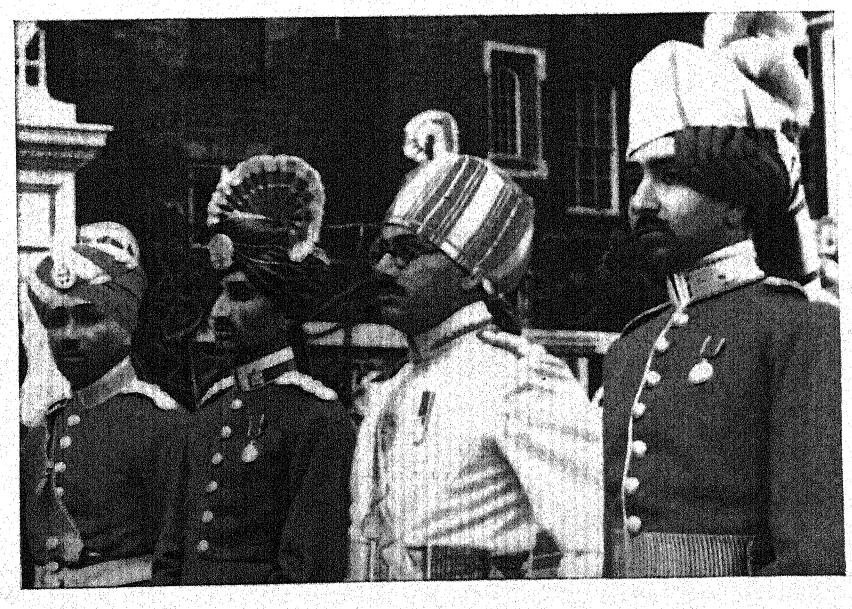
Dufay film transparencies in a considerable range of sizes have proved extremely popular as a simple and highly satisfactory method of making natural colour photographs, both by amateurs and professionals. This photograph was taken on Dufay roll-film, with an anastigmat lens stopped down to f8, exposure 1/25 sec.

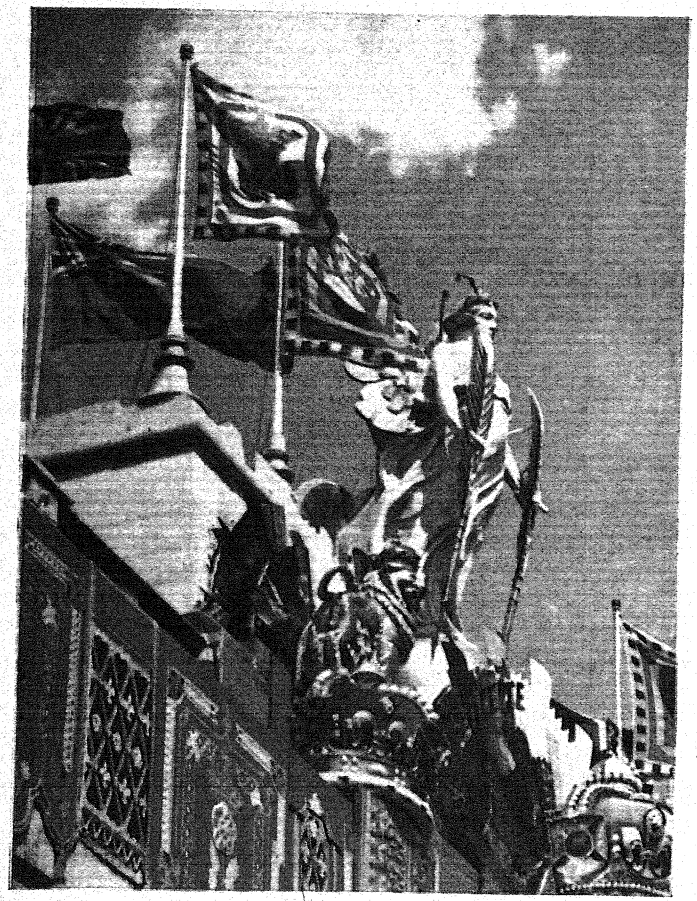
Photo G. H. Fletcher

EASTMAN WASH-OFF RELIEF PRINT

This very successful print of Indian soldiers at the Coronation was made from an Agfacolor transparency (Leica, f4.5, 1/30 sec.). Separation negatives were laid on Panatomic film 9 × 12 cm. and enlarged on to dye-relief films 8½ × 6½ in.

Photo Bernard Alfieri, Jr.







EXAMPLES OF TWO-COLOUR PRINTING (PAPER) PROCESSES

Above, Selfridge's Coronation display, a Chromatone (toning) process print. Taken on an Ilford Hypersensitive pan. plate with a Mikut one-shot colour camera, *f*6.3, 1/100 sec. *(See pages 227 and 396.)*

Right, a portrait by the Duxochrome (pigment) process. Taken on Panatomic film in a Leica *f*4.5. Three filters changed by hand. Exposures—red, 1/8 sec.; green, 1/4 sec.; blue, 1/2 sec. Total time about 2½ secs. *(See page 392.)*

Photos, J. H. Coote and Dr. Hans Sarnow

To face page 393

difference that there is no possibility of frilling with Duxochrome. The hardened colour emulsion will remain showing as a relief ; if the high-lights of the image should refuse to wash clean, the film has been over-exposed, and if gradations are lost in the lighter areas, exposure must be increased.

The colour of the three Duxochrome films, after washing out, remains degraded by the black silver image which is left in the relief, and this is removed with ferricyanide and hypo in the following proportions :

Bleaching Bath

A. Hypo .. .. 16 ozs.
Water to make 32 ozs. of solution
B. Potassium ferricyanide .. .. 1 oz.
Water .. .. 32 ozs.
For use mix :
1 part "A"; 1 part "B"; 4 parts water

Bleaching takes about three minutes, after which the films are washed for ten minutes.

Washing-Out for Colour Balance. The next stage in the Duxochrome process is unique. The three wet films are superimposed in register on the bottom of a white dish for examination, the yellow at the bottom, and the red and the blue on top. Should any one colour predominate, it may be reduced by placing it back into very hot water when a little more of the relief will be washed away. Care should be taken here to see that over-correction is avoided by continually testing and washing out. In this way, if the three elements are not grossly incorrect, colour balance may be obtained.

Local retouching may sometimes be desirable, and a swab of cotton-wool soaked in very hot water may be used to rub gently over the area it is desired to lighten.

The Duxochrome films may be dried either naturally or with the aid of an electric heater, and when this is complete a piece of gelatine-coated transfer paper with the dried yellow film are placed together in cold water for five minutes. After this time remove the paper and film with their emulsions together and squeegee into intimate contact, excluding all air, before placing the sandwich under heavy pressure, either in a copying press or between two heavily weighted boards. After ten minutes remove the film and paper combination, and commence drying naturally or with the aid of gentle heat or a fan. When dry, the paper bearing the yellow image will leave the film of its own accord. Drying needs to be very thorough before the paper will completely leave the celluloid.

The blue film is next placed in cold water together with the transferred yellow image for *one* minute, after which register is obtained by sliding the blue image over the yellow. When register is exact, the two are squeegeed together and placed under pressure as before. The red is added in register to the green image formed by the yellow and blue and the picture is complete.

The glossy surface of the newly transferred print may be made matt by simply immersing in cold water for a few minutes.

COLOUR PHOTOGRAPHY: (6) IMBIBITION PROCESSES

In the following article yet another form of process for producing photographic colour prints is described. Based on a system devised more than fifty years ago, these processes include the following :

(*a*) Pinatype
(*b*) Jos Pé
(*c*) Eastman Wash-Off Relief

An example of the last-named process is given in the Colour Plate facing page 392

THE dye-transfer or imbibition processes can be traced historically to an English patent of L. Warneke, who, in 1881, put forward a process of developing with pyro-ammonia without the addition of sulphite, the untanned gelatine being subsequently washed away with hot water. Several relief forming development formulae were subsequently patented, that of G. Koppmann, using pyrocatechin without sulphite, being commercialized as the Jos Pé process.

The three-colour imbibition process has been applied to cinematograph work with considerable success by the Technicolor Company (*see* Technicolor).

Pinatype Colour Prints. This process is the prototype of all imbibition procedure. It was introduced in 1906 by the German dye firm, Lucius & Brunning, and was based upon methods devised by Edwards in 1875. The process is not so popular today, possibly due to the rather numerous steps

required in working it, but it has the advantage of giving any number of prints from the same set of print plates.

In brief the process requires three positive transparencies to be made from separation negatives. From these three " print plates " are made by exposure on to gelatine-coated plates sensitized with bichromate. The plates are then stained up in tricolour " Pina " dyes, and the areas which were unhardened by light-action absorb the maximum dye, which is next transferred on to a support of gelatine-coated paper.

Since the early days of Pinatype and Jos Pé, the possibilities of using silver emulsion positives to make the print plates have brought us to the modern equivalent known as Eastman Wash-Off Relief.

Jos Pé Colour. Jos Pé is not only a print process but a complete system of colour photography including one-shot cameras.

The process is " relief " and " imbibition " at the same time, as it depends upon varying depths of colourless gelatine to " imbibe " amounts of dye before transfer to paper.

Jos Pé supply sensitized plates from which the reliefs are made, and these are exposed through the back to the usual separation negatives. The speed of the emulsion is about that of an ordinary gaslight lantern plate. The plates are developed in a special Jos Pé developer which contains a tanning agent. Development is observed through the glass side of the plate.

When development is judged to be complete, the positives are transferred to a stop bath made as follows:

Potassium metabisulphite	50 grms.
Water	1 litre

The plates are then immersed in hot water (120° F.), when the unhardened gelatine dissolves from the surface of the plate. The white light may then be turned on, and the relief image dried.

The staining up and transfer of Jos Pé print plates is the same as for Pinatype, and need not be repeated. The three dyes may be obtained with the other materials from Jos Pé, Hamburg 1, Spaldingstrasse 4–8.

Eastman Wash-Off Relief. This most modern form of imbibition colour printing was introduced to England in 1937 by the Eastman Kodak Company, after about two years use in America.

The principles are those of Jos Pé, with modern film for the formation of the necessary reliefs, modern fast dyes of correct colour and low price, and a method of mordanting the transfer paper to avoid " bleeding " or blurring of definition in the transferred dye image. The special film, not containing the final colouring matter but bearing an emulsion (of suitable speed for contact or projection printing) containing a removable yellow dye which by limiting the penetration of light gives in the course of processing a well-graduated relief image, with good printing quality. The depth of the relief is still further limited by the use of a Wratten 39 violet filter between the light source and the film. Development is carried out in D-11 for a period of about 5 min. at 65° F., or until the highest lights begin to veil over.

FORMULAE USED IN EASTMAN WASH-OFF RELIEF FILM

Developer. (D-11)

Water (about 125°F.) (52°C.)	500 ccs.	
Elon	1·0 gm.	15·432 grs.
Sodium sulphite (anhydrous)	75 gms.	42·33 drs.
Hydroquinone	9·0 gms.	138·88 grs.
Sodium carbonate (anhydrous)	25 gms.	14·11 drs.
Potassium bromide	5·0 gms.	77·16 grs.
Water to make..	1 litre	35 fl. ozs.

Wash-off Relief Bleaching Solution
Stock Solution A

Water	500 ccs.	
Ammonium bichromate ..	20 gms.	11·288 drs.
Sulphuric acid (C.P.) ..	14 ccs.	
Water to make..	1 litre	35 fl. ozs.

Stock Solution B

Sodium chloride	45 gms.	25·398 drs.
Water to make..	1 litre	35 fl. ozs.

For use, take 1 part of A, 1 part of B and 10 parts of water.

Non-Hardening Fixing Bath. (F-24)

Water (about 125°F.) (52°C.)	500 ccs.	
Hypo	240 gms.	135·46 drs.
Sodium sulphite (anhydrous)	10 gms.	5·644 drs.
Sodium bisulphite	25 gms.	14·11 drs.
Water to make..	1 litre	35 fl. ozs.

Mordanting Solution

(A)	Aluminium sulphate	200 gms.	112·88 drs.
	Water to make	1 litre	35 fl. ozs.
(B)	Sodium carbonate (anhydrous)	40 gms.	14·576 drs.
	Water to make	500 ccs.	

After development the films are washed for three minutes and fixed in *a non-hardening* fixing bath (F-24), followed by thorough washing in running water. The films are then bleached in an acid bichromate bath (R-10) and transferred directly to water at 110° F., which dissolves away the unaffected gelatine and leaves a hardened relief corresponding to the parent silver image. The three positive reliefs are next dyed up in distilled water solutions of Eastman dyes—A, blue-green ; B, magenta, and C, yellow—allowing 30 minutes dyeing for each. They are then cleared in dilute acetic acid before transferring (magenta or blue-green first) to their final support. This paper support may be any gaslight or bromide paper which has been fixed out, but it should be treated before receiving the dye impressions, in an aluminium sulphate bath made as shown in page 394, which acts as a mordant for the Eastman dyes and improves definition.

The dyes are transferred in succession to the mordanted paper, with the aid of a thin sheet of Kodaloid placed between the relief film and the transfer paper during squeegeeing. The Kodaloid is removed after this, and the relief is left in contact with the paper for 10 to 20 minutes, during which the dye transfers, the same procedure being repeated for the last two colours. Quick drying of the finished print helps to preserve sharp definition.

COLOUR PHOTOGRAPHY: (7) TONING PROCESSES

L. V. Chilton, F.Inst.P., F.R.P.S., and J. H. Coote

Various processes in which three-colour metallic compounds are used for toning from black-and-white positives are described in this section of Colour Photography. Below suitable formulae are given for use in this work and two separate articles follow on : *(a)* Chromatone Process *(b)* Photocolor Bi-Chrome Process

FOR many years colour photographers were attracted by the possibilities of obtaining three-coloured metallic compounds which would give blue-green, magenta and yellow. The first, blue-green, has always been fairly easily obtainable by the cyanotype blue-toning methods as various forms of Prussian Blue were readily obtained in this way and were very nearly of the right colour. A fairly satisfactory yellow is obtainable with lead chromate, or certain mercury salts, and recently nickel dimethyl-glyoxime complexes have come to the fore for the magenta component. Suitable formulae are given below, starting in all cases with black-and-white positive imagines :

Blue-Green. Bleach print in bath A, wash 10 mins., tone in bath B, wash 2 mins. ; fix in 5 per cent. hypo for 2 mins., rinse 2 mins. ; clear in 1 per cent. sulphuric acid and finally wash 10 mins.

Bath A

Potassium ferricyanide ..	25 gms.	386 grs.
Sodium carbonate (crys.)	7 gms.	108 grs.
Ammonium nitrate	7 gms	108 grs.
Sodium chloride	10 gms.	154 grs.
Water to	1 litre	35 fl. ozs.

Bath B

Potassium bromide	5 gms.	77 grs.
Glacial acetic acid	15 ml.	·528 fl. oz.
Ferric alum	5 gms.	77 grs.
Water to	1 litre	35 fl. ozs.

Yellow. Bleach print in bath A, then thoroughly wash and afterwards tone in bath B.

Bath A

Glacial acetic acid	25 ml.	·88 fl. oz.
Lead nitrate	15 gms.	231 grs.
Potassium ferricyanide ..	10 gms.	154 grs.
Water to	1 litre	35 fl. ozs.

Bath B

Potassium dichromate ..	5 gms.	77 grs.
Water to	1 litre	35 fl. ozs.

(Plus ammonia added dropwise to convert orange colour to bright yellow.)

Magenta. Bleach print in equal parts of baths A and B, slightly acidified with nitric or hydrochloric acid, wash thoroughly, tone in bath C for 2–3 mins., re-wash, fix in 5 per cent. hypo. for period of 2 mins., and finally re-wash.

Bath A

Nickel nitrate	50 gms.	14·11 drs.
Calcium nitrate	150 gms.	42·33 drs.
Water to	1 litre	35 fl. ozs.

Bath B

Potassium ferricyanide ..	2 per cent.

Bath C

Dimethyl-glyoxime in methyl alcohol (saturated) ..	100 ml.	3·5 fl. ozs.
Caustic soda (0·4 per cent. solution)	100 ml.	3·5 fl. ozs.
Ammonia conc.	3 ml.	51 minims.
Water to	1 litre	35 fl. ozs.

CHROMATONE PRINTS: HOW TO MAKE THEM

By the Defender Chromatone process prints in full colour are produced quickly and simply. Here the process is explained by Mr. J. H. Coote and formulae and detailed instructions are provided for the practical worker. An example is reproduced in the Colour Plate facing page 393

The Chromatone process is a co-operative product, the toning methods and formulae having been evolved by F. H. Snyder and H. W. Rimbach, Chemists, of New York, and the necessary stripping paper and emulsion manufactured by the Defender Co., Inc., of Rochester, New York.

Starting with three negatives, black-and-white positives are made from these on the special stripping film (Chromatone print paper) about one-thousandth of an inch in thickness when dry. The silver deposits in these positives are now toned yellow, magenta and blue-green, and the three films superimposed in register on a paper base and dried, resulting in a print in full colour.

Chromatone print paper consists of a rapid printing emulsion, for contact or enlarging, coated upon a collodion stripping layer, the whole upon a paper support. The paper must be carefully handled in a fairly deep red bromide safe-light. Development, fixing, etc. are the same as for other projection papers.

Since the Chromatone process reverses the print, exposure should take place from the back of the negatives.

As the effect of the Chromatone process changes the strength of the positives slightly, allowance should be made in the original exposures. Judging by the neutral grey wedge, correct exposure is found by test strips, and this time is given through the green filter negative for the magenta printing, with an increase of 25 per cent. for the blue filter negative or yellow printer, and the red filter, blue toner increased by 10 per cent. (These increases are given assuming the negatives to be balanced.)

Each print should be marked in its toning colour with Indian ink, *i.e.* R., B. and Y., as when the prints are bleached at a later stage confusion may easily occur.

It is preferable to develop all three prints simultaneously in the same developer, and it is better to use developer only once. Fixing is accomplished in the usual manner in acid fixer. If the process is being operated in hot weather and the films become slippery, they may be immersed for a minute in a 10 per cent. formaldehyde bath, just before completion of washing after fixation.

In the fixing bath, or in the early stages of washing, the films can be stripped from their support paper, which is discarded. The separated films should be carefully handled to avoid kinking or tearing.

Normal Chromatone Developer

Metol	15 grs.
Sodium sulphite (anhyd.)	½ oz.
Hydroquinone	60 grs.
Sodium carbonate (anyhd.)	½ oz.
Potassium bromide	25 grs.
Water	40 ozs.

(*Ready for use. Two mins. development at* 65° *F.*)

This formula with normal separation negatives will give correct black-and-white positives for the process.

Acid Fixer

Hypo	8 ozs.
Potassium metabisulphite	½ oz.
Water	32 ozs.

Washing by changes of water is satisfactory if care is taken to move the prints frequently, and to keep the films emulsion side up at all times.

The second step in making Chromatone colour prints is toning, and the following points should be observed throughout:

1. Trays must be rocked continuously during all bleaching and toning operations.
2. Great care must be taken to rinse the hands in clean water between all operations, to avoid contamination and degraded colours.

Apart from the special toners supplied by the Defender Company, three standard solutions may be mixed up as follows:

Dilute Hydrochloric Acid

Hydrochloric acid (strong)	16 ozs.
Distilled water	48 ozs.

Standard Hypo Solution

Hypo	2½ ozs.
Distilled water	32 ozs.

Standard Ferricyanide Solution

Potassium ferricyanide	½ oz.
Distilled water	4 ozs.

The ferricyanide should not be kept more than about four days at a time.

Bleaching of the red and blue elements takes place in the same bath, the working solution made up as follows:

Water	1 oz.
Red and blue toner A	1 oz.
Standard ferricyanide solution	1½ drs.

(*Sufficient for half-plate prints.*)

After about 15 minutes, and when the black silver image has been completely bleached from both films, they are changed to running water, where they are washed for 10 minutes.

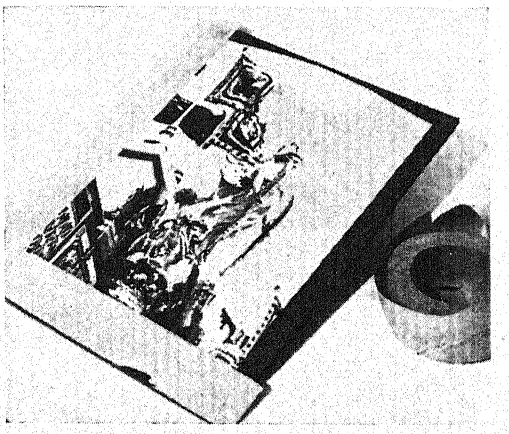
The red print is then placed in red toner B and allowed to tone magenta for about 10 minutes. This solution is saved for further use. The film is then placed in the standard hypo solution for three minutes before final thorough washing. The magenta element is then ready for assembly.

Similarly the blue image is placed in the blue toner B and allowed to tone for about 10 minutes, and this toner again poured off for further use. The film is next immersed in weak hydrochloric acid for 1 minute, using one part of the dilute acid and one part water. Thorough washing follows before transfer to standard hypo until the greenish tones have changed to blue. Finally, washing for 15 minutes leaves the blue element ready for the print.

The yellow bleach is supplied in two solutions, and is made up as follows :

Yellow toner A. No. 1.	1 oz.
Yellow toner B. No. 2	1 oz.
Standard ferricyanide solution	1½ drs.

The yellow printer film is bleached for 15 minutes, when the solution is poured off into a measure and three drachms of standard hypo are added to every 2 ounces of working solution. Next the film is washed for 2 minutes before replacing in the dish and pouring the solution back on the film. The dish should be rocked vigorously at this stage



CHROMATONE PRINT. When completed the Chromatone print is trimmed and held around the edges with gummed paper as seen above. This print is reproduced in actual colour in the plate facing page 393



CHROMATONE OUTFIT. The various materials required for making prints by the Defender Chromatone process are available in convenient form. The different solutions are bottled and clearly labelled

to avoid streaking of the yellow image. After 3 minutes in the solution the yellow film is rinsed in water and immersed in :

Standard hypo solution	1 part
Water	3 parts

Do not keep the prints more than 1 minute in this solution. Wash the film immediately for not less than 20 minutes. The yellow image is toned for 2 minutes in yellow toner B and finally washed for 20 minutes.

The final assembly is quick and simple. The three coloured images are superimposed in register with the yellow at the base and the magenta in the middle on a fully soaked piece of gelatine base paper. All the elements are in turn squeegeed firmly into place, after which the print is allowed 10 minutes in which to become partly dry. Next the print should be trimmed so that the edges of the film layers are flush and the whole fastened down to a waterproof board by means of gummed tape round the edges.

After drying, the print is removed from the board by running a knife round the edge and lifting the picture away. Ordinarily, Chromatone prints dry with a high gloss, and if a matt surface is preferred, rubbing the surface of the print with fine dry pumice will give this result.

At the time of writing Tri-Tone would seem to be the English equivalent to Chromatone. The process is " all toning," and makes use of materials made in this country, costing remarkably little. The results definitely rank with the best of tricolour Carbro, and are naturally obtainable much more simply.

PHOTOCOLOR BI-CHROME PRINT PROCESS

A method of making colour prints is described here which produces an almost perfect three-colour rendering, although only two colour elements are necessary in the process

Frankly acknowledging his debts, Mr. A. H. Phillips, the inventor of the Photocolor Bi-Chrome process, describes his invention as being conceived by Ducos du Hauron and advanced by the late F. E. Ives, whose Polychrome process must form a base upon which all two-colour compromise methods of colour photography build their structure.

It was in 1895 that Ducos du Hauron first suggested the use of only two of the primaries —red and blue—as a means of making a colour picture. This, in a sense, was pure two-colour photography, but out of this original suggestion grew the beginnings of what was later known as " compromise " colour processing in which the spectrum was roughly divided into orange (to combine red and yellow) and bluish green (to combine blue and green). Thus various orange and blue-green printing colours were used and, for a time, two-colour compromise photography (especially with the suggestion of a bi-pack) promised to revolutionize the field of colour.

Its serious lack of pure yellow and blue, however, soon made itself felt, and with the introduction of easier methods of producing full three-colour prints, and also the advance of negative material, the compromise processes fell into discard except in cinematographic work, where the lack of yellow was compensated for, to a certain extent, by the yellowness of the projection light.

Polychrome Process

In 1921 F. E. Ives offered a new compromise process, which he called the Polychrome process. Here, as in the original method, only two negative elements were used, but the method of print-making was radically altered. In place of the blue-green element, a pure cyan-blue base print was made. Thus true differentiation between foliage and sky was possible for the first time in two-colour reproduction. In place of the orange-toned, or dyed, element, a relief print was made which actually carried red—through orange—to yellow colouring. The latter was the really important element of the Ives' invention, and was called a " dichroic effect."

Unfortunately, the invention came at a time when Ives had grown old and somewhat past the ability to make a really practical development of his idea. Furthermore, as is contended by Mr. Phillips, the description of dichroism was an erroneous explanation of the dye phenomena in the red-to-yellow image, and it was from this point that the really practical and extremely simple development of Photocolor's Bi-Chrome process commenced.

Two-Colour Elements

The idea of a base blue-print was adhered to, but an entirely different method of obtaining the red-to-yellow element was invented. In this latter element red, in the object photographed, is represented by heavy deposits of gelatine, orange by medium deposits, and yellow by the lightest of deposits. By the use of a red and yellow dye which have differing affinities for gelatine, the Photocolor process enables red to be taken up by the heavy deposits, orange by the medium deposits, and yellow by the light deposits, thus producing in one element three hues which, combining with the blue print, give almost perfect three-colour rendering.

Two-colour work is sometimes despised, but often it is more simple to get an attractive, if not perfect, two-colour print than one in three colours. Bi-pack, which gives the two separation negatives for two-colour work, enables the user to obtain snapshot exposures at quite high speeds with most standard cameras.

There are several makers of 35-mm. bi-packs—Agfa, Gevaert and Defender.

Bleach-Out Processes

The only bleach-out process at all generally remembered in these days is Utocolor, made according to the formula of the late J. H. Smith. It had a temporary vogue, but as with all bleach-out papers the image was formed by the bleaching of dyes exposed under colour transparencies, and it proved impossible to fix the image to resist the effect of light after formation of the colour print.

COLOUR PHOTOGRAPHY: (8) GENERAL NOTES FOR AMATEUR WORKERS

Bernard Alfieri, Jr.

For the sake of amateurs the author brings together the most important points which have been discussed at length in the earlier articles of this series. The films available for colour work (with special reference to Dufay, Lumière, Kodachrome and Agfacolor) the type and treatment of subjects, lighting, and filters are all considered here in brief

MODIFICATIONS and improvements to old processes, new techniques, and simplified methods of handling, have brought colour photography within the scope of every amateur worker. With some colour films it is just as simple to load the camera and make an exposure as it is with monochrome, no external filters or modifications to the camera being required, and in some cases the purchase price of the film includes the charge for processing. On the other hand, just as it is necessary to learn what can be done with an ordinary film for black-and-white work, so successful colour photography demands at least an elementary knowledge of the medium.

From the amateur standpoint there are a few films available in various forms which can be used in almost any camera and do not require special filters. Of these Dufaycolor is supplied in sizes to fit all popular makes of cameras, Lumière Ultra-Rapid Filmcolor and Lumicolor are made in art film and roll-film respectively, and Kodachrome film in most sizes will ultimately be marketed. Both Kodachrome and Agfacolor have proved successful in 35-mm. film for use in miniature cameras, and neither requires external filters when used in daylight. The speed of these films has brought colour photography within the range of the hand camera, and under favourable conditions they can be used for photographing moving subjects, and obtaining coloured pictures that would be impossible by other means.

Exposures and Subjects

As a rough guide to possible exposures, on a bright summer's day in direct sunshine, with a light-coloured subject, it is possible to obtain sufficient exposure with a shutter speed of 1/50 sec. at *f*8. Dufaycolor and Kodachrome are faster than Agfacolor, the latter being rated by the makers at from 16° to 17° Scheiner, but even at this speed good instantaneous exposures can be obtained in bright light.

The type of subject suitable for colour photographs is not always one containing brilliant colours of every shade. Just as the beauty of many black-and-white photographs lies in the contrast of the main subject against a subdued background, so a colour photograph, where the brilliance of the colour is confined to the principal theme, will present a colour contrast which is often more pleasing than an intricate mass of bright colour all over the picture.

Lighting Conditions

The contrast in a colour photograph is not confined to lighting conditions, but includes change of colour, and where two entirely different colours of nearly the same depth of tone would present a flat subject in black and white, the difference in shade may produce great contrast in colour. However excellent colour films may be, they cannot yet cope with excessive lighting contrast, and this must be remembered when choosing a subject. If all the colours of the spectrum were arranged as pieces of coloured paper, evenly lit, and photographed on any of the available colour films, a very accurate reproduction of the colours would be obtained combined with a reasonable latitude in exposure. In selecting a natural subject the same colours may be present, but because of excessive lighting in some parts of the subject and perhaps heavy shadows in another, the latitude in the exposure of the film to cover both under-and over-exposure in the same subject necessitates much greater accuracy in judging the best shutter speed and lens stop, and if the lighting is of a very contrasty nature the colour rendering will suffer.

The amateur who only requires a pleasing colour effect and is not going to be excessively critical will find any of the well-known

makes of colour-film excellent under most lighting conditions, but the discriminating worker will have to select subject matter with much greater care. Amongst the most common troubles experienced with colour films is a tendency for any predominating colour covering a large portion of the picture to be present in small light portions of the subject.

For instance, if a white cottage is photographed against a deep blue sky, the colour of the cottage may be shown as pale blue instead of white, light clothing on a figure against a bright background may disclose a pale shade similar to the background, while deep shadows are usually blue. This is often so in nature, although the film may exaggerate it.

Front Lighting

In many subjects a flat front lighting that would be uninteresting in monochrome work is quite satisfactory in colour, but in order to obtain good roundness or third-dimensional tones the sun should be to one side of the camera and excessive shadow should be avoided. Pictures against the light are by no means impossible in colour, but they should not be attempted in very brilliant sunshine, the ideal time being when the sun is partially overcast with thin cloud.

Although colour filters are not necessary as a general rule in daylight exposures, special filters are sold for different purposes and must be used with discretion. On no account should filters marketed for one colour film be employed on another. In each case such filters have been balanced for a particular film and would produce quite a different effect if used for a similar purpose on a film of another type.

Kodachrome film is supplied in two types, one for use in daylight, and another (Type A) balanced for artificial light. A filter can be used which will allow the latter to be employed in daylight, and a haze-cutting filter is available for the regular or daylight film.

Agfacolor provide a pale blue filter (No. 28) for use on special occasions when red and yellow light predominates, and a special filter (29B) for high altitudes. There is also a series of filters available for Dufaycolor, which embrace various forms of artificial light, but in every case, with each make of film, filters are provided for special purposes, and the amateur is recommended to become familiar with straightforward exposures before extending the work into special fields.

Indoors, good colour results may be obtained with most forms of artificial light, including flash-bulbs. Kodachrome (Type A) in particular is exceedingly fast and may be exposed almost as a medium speed ordinary film. Lighting arrangements are slightly different from those usually employed for monochrome. A good, general flat lighting is advisable, and back lighting may be added to increase the subject interest. Just what liberties may be taken with artificial light can only be gauged by experience, but with some films great lighting contrast may be employed, provided excessive shadow detail is not present.

The best results, both in daylight and artificial light, are those where accuracy of exposure combined with suitable lighting brings the colour values well within the latitude of the film, and a good exposure meter, preferably of the photo-electric cell type, is essential.

Having assumed that an excellent colour film has been produced, and the cost of printing on paper by means of separation negatives is out of the question, some easy means of presenting them is desirable.

Projection

Large size films can be viewed preferably by reflected light, but small films from a miniature camera require some form of magnification. Projectors are available that will accommodate lengths of film without cutting, but in most cases a small lantern-slide where the film is protected between glass is preferable. In order to project small slides without loss of colour, even to moderate sizes such as a screen of about 4 feet in width, an illuminant of not less than 150 watts will be required. The slides should be protected from exposure to direct sunshine to prevent fading, and should not be shown in a powerful projector for long periods, or there may be a possibility of damaging the film by excessive heat.

An interesting development is that of colour stereoscopic slides, to be viewed through a stereoscope or projected on a metal screen. The light projected from each of the

paired images is polarized and the twin projected image is viewed through glasses made from polarizing screens with their vibration planes in a setting to confine each image to the corresponding eye, producing an effect of stereoscopic colour photography.

In view of the apparatus supplied with the Leica camera, the twin images can be produced on a single exposure and are projected by one lens, the image being divided by means of a prismatic device.—

BERNARD ALFIERI, JR.

COLOURING PHOTOGRAPHS WITH DIFFERENT MEDIUMS

Certain types of photograph lend themselves to colouring, and by the skilful application of dyes, water colours or transparent oils artistic effects can be obtained. Mr. Alfieri, Jr. here explains how these different mediums are manipulated

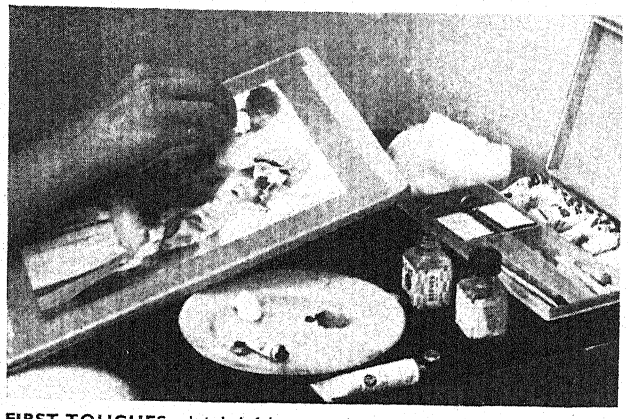
Tinting and colouring prints may be done with many mediums, each method requiring special handling according to the nature of the colour. Either dyes, water colours, or transparent oils can be employed, but in all cases the success of the result not only depends on the skill of the operator but on the production of suitable prints for colouring. Each method is merely a means of general tinting, relying on the detail of the photographic print supplying not only the various tones but also the detail drawing. If the print is dull and heavy in tone, transparent colour cannot brighten it; while if the print is excessively contrasty with deep blacks and clear whites, the colours may be brilliant in the light portions, but cannot show up over a very dark ground. Different mediums require various types of print, but as a general rule they should be bright and fairly contrasty, with the maximum amount of detail in the light portions, no dead blacks, and often on the pale side. The actual contrast between subject matter will be, to a certain extent, provided by the change of colours, and all that we require of the completed photograph is to provide the difference in tone, and clear drawing.

Dyes or Photo-Tints. The gelatine surface of a bromide print readily absorbs dye, and although special instructions must be followed for particular products, the general method is to soak the print for about fifteen minutes and then place it face up on glass, swabbing off the surplus moisture. The stains are first applied in a very dilute form, as it is easy to increase the depth by further applications, but usually impossible to reduce the colour once the gelatine has been dyed. The large surfaces, such as a sky, are stained first, either with a tuft of cotton-wool or a fairly large brush, dabbing off any surplus as quickly as possible. Once the large areas have been covered, fine detail can be picked out with a small brush, using undiluted colour where necessary.

The actual depth of tone will be provided by the photograph, but in exceptional cases a little body-colour (a good quality water-colour mixed with white) can be applied to very small portions of the print. Most sets of photo-tints are made up of the essential shades, a mixture of which will provide any colour, such as: blue and yellow, green; red and yellow, orange; red and blue, violet. All three together will produce either grey or brown according to the proportion. In some cases the colours are supplied for their brilliance, and where the green is very crude it can be mellowed down with brown, to the various shades required for tree green, or mixed with blue to make turquoise, or yellow for sap green.

Where large patches of colour only are required, a print can have certain portions reserved by painting on a thick copal varnish, and then be submerged in a dish of dye until a sufficient depth of colour has been absorbed, after which it is washed and the varnish removed with a suitable solvent, such as turpentine, benzine, etc., when other parts already stained can be reserved, and the print again submerged in another dye colour. In some cases, such as a seascape, where a single small object such as a ship can be reserved, the print as a whole can be dyed to the sky colour and the sea portion swabbed over with a suitable green, after which the reserved portions can have the thick copal varnish removed and the fine colour detail of the boat applied with a small brush.

Pastel Tinting. Pale and very beautiful colourings can be obtained by the use of pastels. The print must be on a matt surface paper, and is worked dry. The pastel crayon is usually applied by means of a stump, the tip of which is rubbed on the



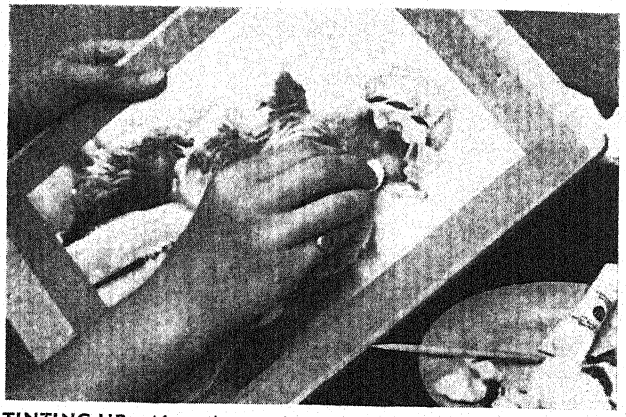
FIRST TOUCHES. It is helpful to stretch the print on a drawing board by gum tape fixed round the edges. Big patches are put in first with more colour than will be required, rubbing down to the desired shade

crayon and then transferred to the surface of the print. Parts may be softened with tufts of cotton-wool or entirely removed with an india-rubber.

In some cases a print will not readily take the crayon, and it must either be well rubbed over with fine pumice powder, or special surface powder which gives a "tooth" to the print.

Transparent Oil Colours. Many oil colours are practically transparent, and sets of specially selected colours can be purchased for tinting photographs. Prints skilfully coloured with oils possess a beauty which is confined to this medium, but the prints themselves must be made to suit the medium, being rather on the faint side with a high key lighting and an entire absence of deep shadow or black portions. In portraiture the prints should be toned sepia, and a rough surface paper should be employed.

It is helpful to wet the print and place it on a small drawing board, sticking down the edges with strips of gum-paper, to stretch it. When thoroughly dry, the print may be rubbed all over with a medium, such as one part each of boiled linseed oil and copal varnish to four parts of turpentine. Or, on the other hand, the paper may be well damped with turpentine alone.



TINTING-UP. After colouring the background and large areas the smaller parts are tinted up and afterwards rubbed down with tufts of cotton-wool, as shown here



BRUSH WORK. Small bright portions of a subject can be painted in with a brush. Surplus colour is removed with cotton-wool

Photos, Bernard Alfieri, Jr.

The colour is applied in exactly the opposite manner to that used with water colour or dyes; it is applied very much darker than is required with ample tufts of cotton-wool, and then very gently rubbed down to the shade which it is desired to obtain.

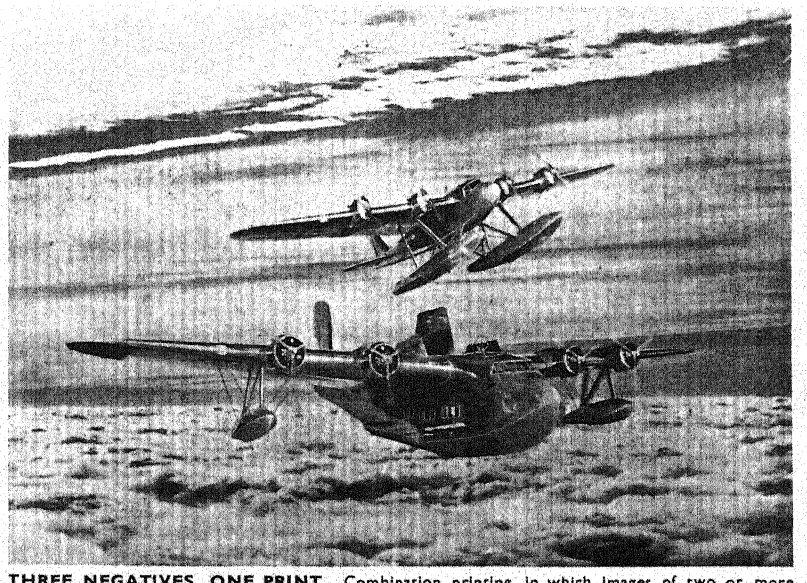
It will be found best to cover the large areas first, not troubling to go round any small portions of the subject, and after this has been rubbed down to the desired shade the colour which impinges on other parts of the subject is removed with cleaning fluid. A transparent medium can be purchased which it is possible to mix with the colours where required, and this can be used as a less drastic cleaner for removing surplus colour. One of the chief

joys to the beginner working with oils is the fact that if the print is not progressing satisfactorily, all the colour can be washed off with turpentine, and the work started again. It will be found that oil colours blend perfectly, and shades can be mixed to produce almost any colour from a stock of about six tubes, although a complete set of colours sold for general work simplifies the mixing and adds to the comfort of working.—*BERNARD ALFIERI, JR.*

COMBINATION PRINTING. A combination of images from two or more negatives upon one and the same print or lantern-slide has several practical uses, probably the principal one being the printing-in of clouds upon an otherwise "bald" landscape. Other uses include the combination of a portrait photograph with a background consisting of a reproduction of a pencil sketch, and the inclusion in a group of people of a person absent at the time of taking the photograph, or one whose appearance in another photograph is preferred for some reason or another. Any desired object or pet can be similarly added to complete the picture.

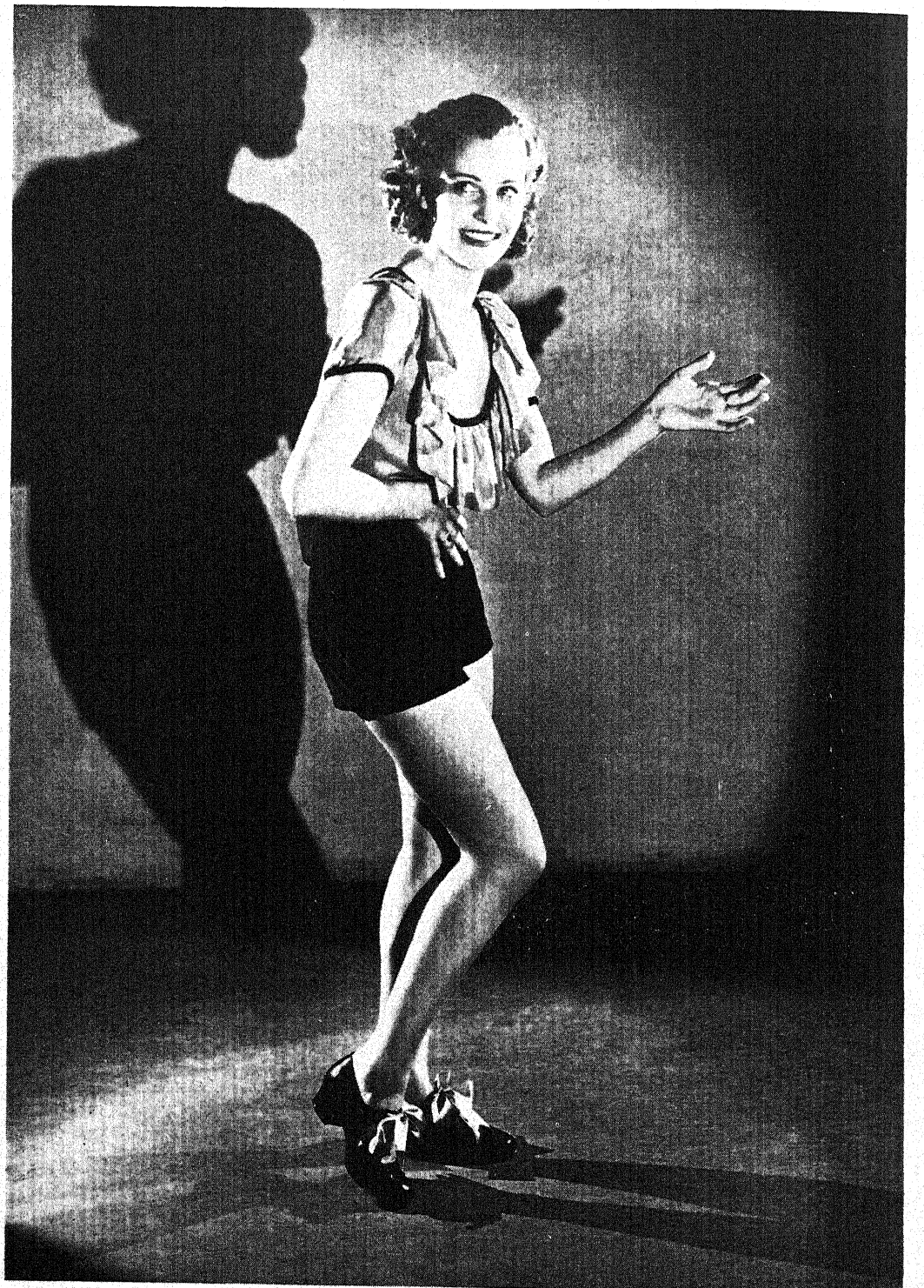
When contact-printing on daylight print-out paper was more in vogue, the matter was comparatively simple, because, having ensured a suitable portion of the print remaining white for inclusion of the detail to be introduced, the matter already printed could be covered up and the progress of printing the second image into the white space could be seen and watched. The necessary covering up, or "masking," could be arranged either in diffused fashion by moving the edge of a card torn roughly to shape, or precisely by painting with opaque water-colour (afterwards removed while processing) over the portion of the print already visible.

With the prevalent development-printing processes the matter is somewhat similarly dealt with, but calls for more judgement and more precision in pre-arrangement of the masking devices used, since the entire combination is effected before development reveals the result. For work requiring a precise joining-in of details, probably the best method is to project the first image on the easel of an enlarger, on which a sheet of opaque paper is laid. Then, with a sharp blade, the specific outline is cut, so that the pieces form a mask and its counterpart, by interchange of which the two images may be printed in correct register. Naturally great care is necessary to ensure absolute registration, and even then some retouching of the outlines may be needed. Using this method at some little distance from the easel the outlines can be blended rather than precisely fitted into one another, and an elaborated form of this method is used in producing one variety of photomontage (*q.v.*). Where accuracy of outline demands finer methods, a mask can be made by painting on thin celluloid or cellophane laid over the image on the enlarging easel.



THREE NEGATIVES, ONE PRINT. Combination printing, in which images of two or more negatives are made to appear in a single picture, has many applications. Here is an example. The two machines are models of the Short-Mayo composite aircraft and each was photographed separately, while the clouds and sky were printed in from a third photograph. The printing process obviously involves the use of masking devices

Photo, Fox



CABARET ARTISTE. The pose of the girl in this photograph, her clothes and the multi-angle lighting combine in giving an atmosphere of the stage. The artificiality of the whole has been made deliberately to be in keeping with the subject, which is unmistakably theatrical, and the picture is a good example of the commercial photographer's art

Photo, Fox

COMMERCIAL PHOTOGRAPHY: ITS MODERN PRACTICE

David Charles, F.R.P.S.

Author of ' Commercial Photography ' and ' Brighter Photography '

The present-day needs of commerce and industry provide the professional photographer with the widest scope and, at the same time, make it essential that he shall have extensive knowledge, initiative and organizing ability. Here Mr. Charles makes a critical survey of the subject, dealing first with the main factors and then the technical aspects of commercial photography

See also Advertising Photography ; Industrial Photography

COMMERCIAL photography—that is to say, photography done for business purposes other than pictorial advertisement illustration—is not so much a specialized branch of photography as an agglomeration of various branches. Usually the commercial photographer has to be a " Jack-of-all-trades," ready to turn his hand to anything photographic. The treatment of a subject by a commercial photographer may be different from that given to it, say, for purely pictorial purposes, but the essential factors of photography in commerce lie mainly elsewhere.

Urgency. One of these factors is that the subject must usually be photographed immediately. Whether conditions happen to be favourable or otherwise to good technique or artistry will make that subject either an easy or an extremely difficult one to portray satisfactorily. A great part of the commercial photographer's time and skill is occupied in making technically passable photographs of subjects whose appearance and surroundings are wholly uninspiring.

Variety. Another factor is the extreme variety of the subjects handled by a commercial photographer, and the correspondingly varied technique he uses to cope with them. He must therefore be well equipped with apparatus. This may consist of specialized gear for each distinct type of work he undertakes ; but more usually it will be of an adaptable character, of " general purpose " description. His mental equipment, too, should be such as to enable him to adapt his technique readily to the constantly changing problems of his subjects.

A third factor lies in the different purposes for which the photographs may be required. The photographer's recognition of these, as well as of the essential points of any individual subject, must often govern his selection of technical procedure. Therefore the practitioner in commercial photography should possess either an ample " general knowledge," or else the faculty of very swiftly assimilating the necessary knowledge.

Production Speed. A fourth factor is the speed with which he is usually required to produce finished results. This and the moderately large size of prints he usually makes on glossy paper mean that his processing arrangements must be smooth working as well as easily adaptable to widely varying procedure. Although as regards speed commercial photography is not so exacting as press work, it is much more critically examined.

Exterior. A commercial photographer may be required to attend a factory. If he is to photograph the exterior, he will bring to bear all his knowledge of and suitable apparatus for architectural photography. Should the building be in a narrow street or otherwise badly situated, he will need an extreme wide-angle lens combined probably with extreme rising-front. Should it be a rainy day, he will require, in addition, the use of a filter ; if the light be unfavourable in direction, he will require either patience to wait a few hours or the knowledge of how to deal satisfactorily with this added complication at the time. He will certainly require the use of tact, either to persuade curious onlookers to stay outside his field of view, or to obtain permission for the use of an elevated viewpoint opposite. To " stop " the traffic, photographically speaking, or to make it disappear from his results, entails selection of method and successful application.

Interior. If it is to be next a series of interiors of the factory, the points of view and the technique adopted will be selected and modified, according to whether it is the architectural detail, the lighting installation, or the machinery which is the subject matter.



PUBLICITY PORTRAITURE. The use of personalities or characters in advertisements is a popular and effective means of publicity, and many manufacturing concerns have adopted it for newspaper and poster display. Here is the kind of photograph that the commercial photographer is called upon to produce in collaboration with the advertising department of, say, a tobacco company

Photo, Fox

It is practically certain that the photographer will need to keep a good look-out for and have removed multitudes of such things as handbags, packets of sandwiches, overalls, pieces of scrap material and other litter. All such things catch the eye in a photograph far more emphatically than they appear to do in the place itself. The luncheon hour is often a good time for speedily photographing a set of workshop interiors.

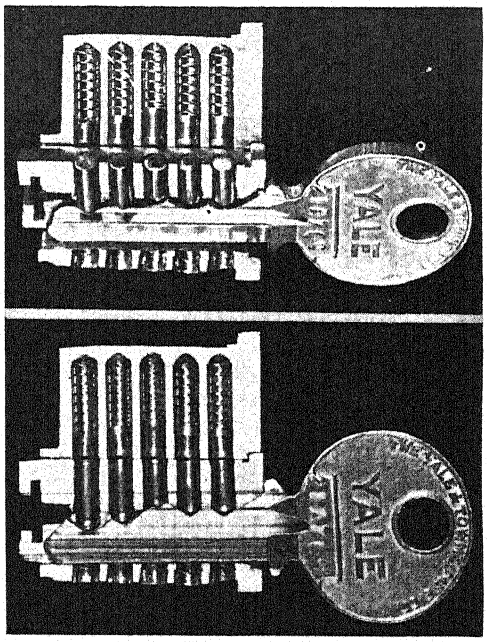
Action. If people are to be shown actually at work it will rarely be practicable to use the fine covering power of an extreme wide-angle but slow lens, because workpeople will fidget. A lens of larger aperture, with consequently decreased depth of definition and of covering power, is required. Much may be done to compensate for the loss of depth by employing an elevated viewpoint, and by the use of the forward swing to the lens (*see* Swing-Front). It is often useful to employ flashlights or portable lamps to increase the available light and keep exposures down. It is essential to make those in the picture appear as though actually working, and to stop them moving or grinning at the camera.

It might next be suggested that an individual machine, perhaps also with someone working it, would better illustrate an interesting feature of the manufacturing process. Such pseudo " action " photographs are, in fact, very widely used for instructional leaflets on how to use and to adjust all sorts of mechanical devices.

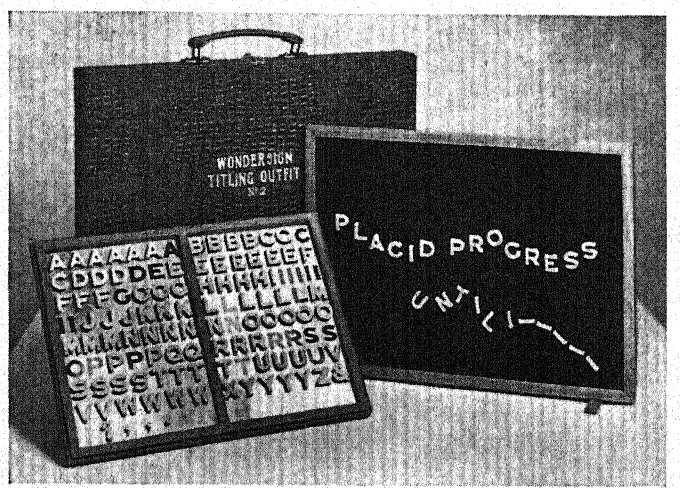
Close-Up. In the case of parts of a machine alone the photographer can often find opportunities of producing very bold designs by using the contrasts and angles of polished parts against darker masses. He may discover that this sort of picture is not only far easier than all the rest to make, but that the character of the prints brings him greater credit, not only from the individual client but even amongst those of his brother photographers whose work is not connected with mechanics. The points

to be noticed are, first, to avoid the distortion of a short-focus lens, and then to get the definition of the background subdued, so that the boldness of the " design " is accentuated. Next, because one is using contrast at closer quarters, undue dirtiness or untidiness will be more than ever noticeable. On the other hand, the machine should seldom be cleaned up for the purpose of photographing. A polished though now dirty rod will photograph as though new if an oily rag is wiped straight along it ; and much of the characteristic litter of waste turnings or other material may be made very effective if its crudest features be judiciously removed or subdued. The question of verticals is important. Either the photographer should be scrupulous upon getting the verticals of a machine perfectly upright, or he should make obviously intentional angle-views.

Model. If somebody is to be shown using the machine, the photographer will need to use his own discretion, if possible, in selecting a " type " for a model. All too often the foreman will send along some moron or other, simply because his time is the least valuable. Tact will be needed to get a usually very self-conscious model to act the part naturally as well as to keep in check the healthy but disconcerting ribaldry of the rest. All this kind of work must usually be done very quickly. For one thing, such untrained models soon get tired and assume stiff attitudes and expressions, and for another it is often necessary to have the whole machinery stopped. This proceeding costs the client a considerable sum for the loss in production. The purposes of having the machinery stopped at all are first to ensure that the model shall be under vocal control, and second, to avoid the continuous vibration which may spoil the definition of the photographs.



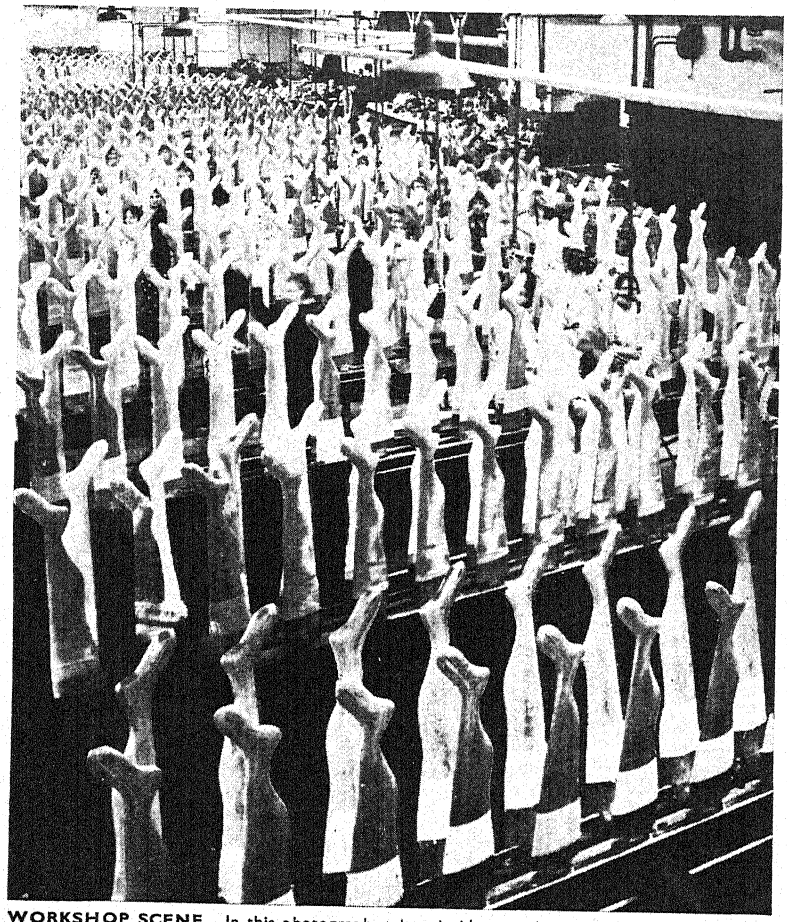
SMALL-PART CLOSE-UP. Resourcefulness in commercial photography is not confined to details of technique. In making these explanatory photographs of a Yale lock, the difficulty of retaining the small parts in place was overcome by glueing them
Photo, David Charles



LAYOUT. Here is a publicity photograph which by intelligent arrangement is both attractive and explanatory. All the features of the product, a titling outfit, are shown, together with an example of its application
Photo, David Charles

Hands. If the machine, the tool or the device to be illustrated is of small size it may be desirable to include only the hands of the operator. This particular kind of close-up work accentuates all the problems connected with close-ups of small objects, and at the same time brings with it several new ones, while by no means removing those connected with the use of a model. The special points to be noted may be briefly described as follows:

Using a strong direct light to give relief to the details of the subject does either of two



WORKSHOP SCENE. In this photograph, taken inside a stocking factory, a striking effect has been obtained by choosing an elevated viewpoint. Had the picture been taken at a lower level the scene would have been crowded and confused

Photo, David Charles

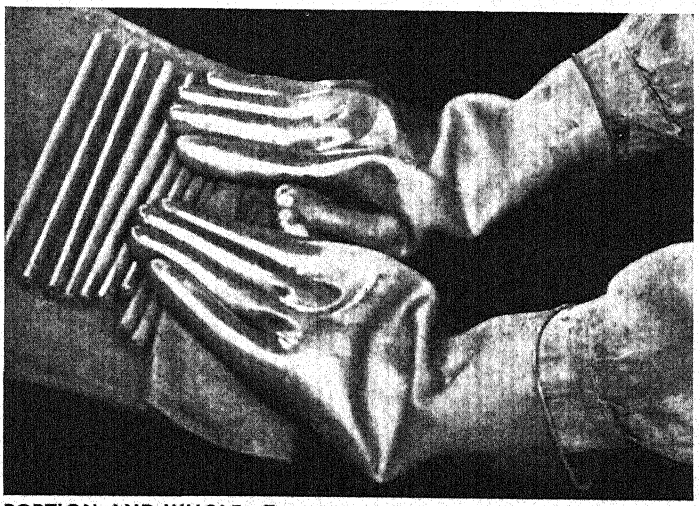
things to the hands; either it "overlights" them and makes them appear like plaster casts, or it accentuates their roughness and dirtiness, according to their type. Choice of sensitive material complicates this very issue. Panchromatics markedly increase any tendency towards undue whiteness; other material exaggerates crudeness of skin. Then there is the fact that such close-ups (*q.v.*) not only tend to increase the apparent size of the hands but entail the use of comparatively small lens-apertures, which increases exposures and so does not diminish the risk of movement during exposure. It is permissible to employ any means which may be available to support and steady the hands, short of showing that support in the picture or placing the hands in an untrue position, as is all too often done. For instance, I have seen a workman's finger, to steady his hand for such an "action" photograph, hooked around something which, in real life, would instantly slice that finger off. Nor does a compositor, for instance, set type with his hands resting on a table. He does it in mid-air, and in mid-air should his action be shown. These are the sort of mistakes that the commercial photographer must avoid.

Objects. The next thing the photographer will be asked to photograph will probably be some of the products in their various stages of manufacture. The photography of manufactured articles for catalogue illustration is undertaken in large numbers by many commercial photographers. He may be allowed to take these to his studio, or he may be required to do the work on the spot, using such lighting, backgrounds, and means of support as he can improvise. I have known many operators produce a second-rate result in these circumstances through a feeling of diffidence in obtaining the essentials for such work. In the drawing-office or packing-room of most factories are rolls or reams of large sheets of white or brown paper; in the carpenters' shops are sheets of plywood. With the aid of these and some tacks or drawing-pins it is seldom difficult to arrange changes of clean bench and background in the dirtiest factory. It is often taken for granted that since an unsuitable background can be painted out in the negative it matters little of what the background consists. The fact is that the character of the background and

of other immediate surroundings exerts profound influences upon the reproduction of the subject itself. The more shiny or semi-shiny surfaces the subject has, the greater will this influence be.

Cartons. It is not unlikely that the finished product in its printed carton will be one of the required subjects. This apparently simple subject presents problems of its own. The first point is that a carton is a subject with verticals which must be kept so in the photograph. Therefore it must be stood on a level bench and the camera-back must be strictly vertical too. The fact of being quite close to the subject will accentuate errors in this respect. But at the same time it is usual to show the top as well as the front and side of a carton ; otherwise it has no shape. This entails use of a considerable drop-front, which brings in its train the need of a comparatively long-focus objective of great covering-power, together with considerable extra-extension in the camera itself.



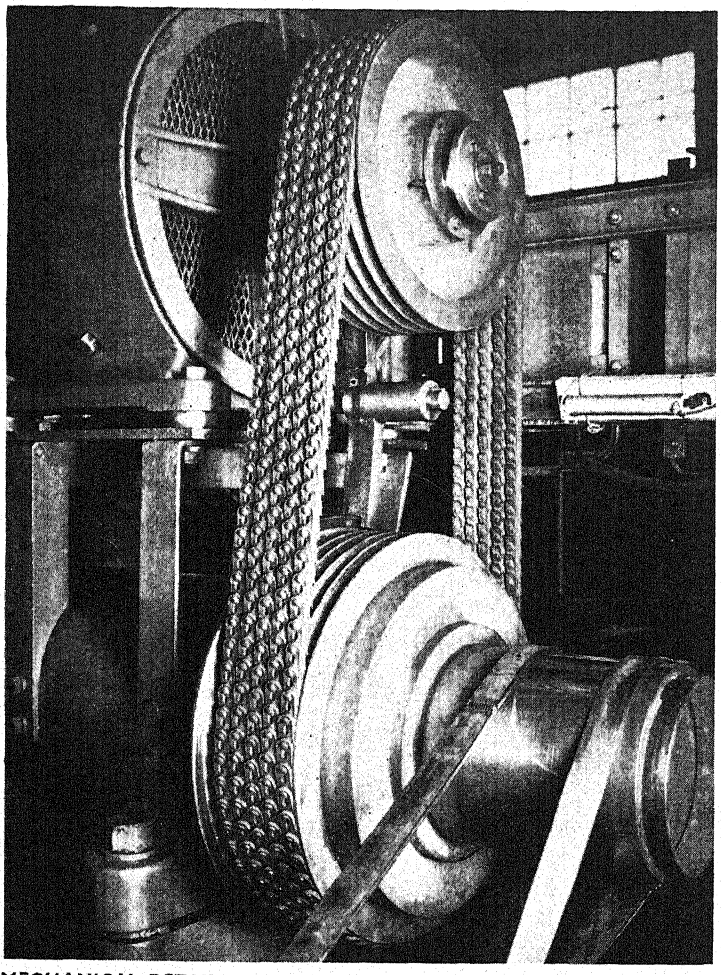


PORTION AND WHOLE. Two photographs which show how an improvement can be made by selecting and enlarging a portion taken from the whole. The upper picture, showing a process of manufacture, is indefinite and emphasizes the suggestion of untidiness in the factory. In the lower photograph the operation is made clear

Photos, David Charles

The second characteristic of cartons which calls for special note is their colouring. The colours favoured by carton printers are frequently those which give photographers great trouble, unless a full compensation filter is used upon panchromatic material. A certain red and pale yellow are especially prevalent, and are apt to be reproduced as black on other than panchromatic emulsion ; while on the latter used without the proper filter they often become almost invisible in the result. In this, as in many other kinds of commercial work, accuracy of exposure is critical. On account of the continually changing conditions under which he works, the commercial photographer cannot afford to rely too much on the " latitude " of his sensitive material.

Portraits. The commercial photographer may be asked, after all this, to make a portrait of the managing director or other execu-



MECHANICAL DETAIL. In photographing machinery the photographer must give special attention to lighting in order to obtain emphasis in the light and shade falling on the smaller features in the mechanism. Here is an example, with details brought out by effective lighting

Photo, David Charles

tive. This photograph may be required to decorate the brochure which the other photographs are to illustrate, or it may be wanted to adorn a " review " in the trade paper of the particular industry. If a satisfactory " likeness " is obtained it may be approved as a change from the formal studio portrait.

Colour, Cine, Micro. The commercial photographer is sometimes asked further if he can make photographs in colour of some of the subjects which he has been handling, or if he is prepared to make sub-standard cinematograph films of the work in progress. Some of the smaller parts or products may be required on a much larger scale than their actual size, and may call for a knowledge of low-power photo-micrography (*q.v.*).

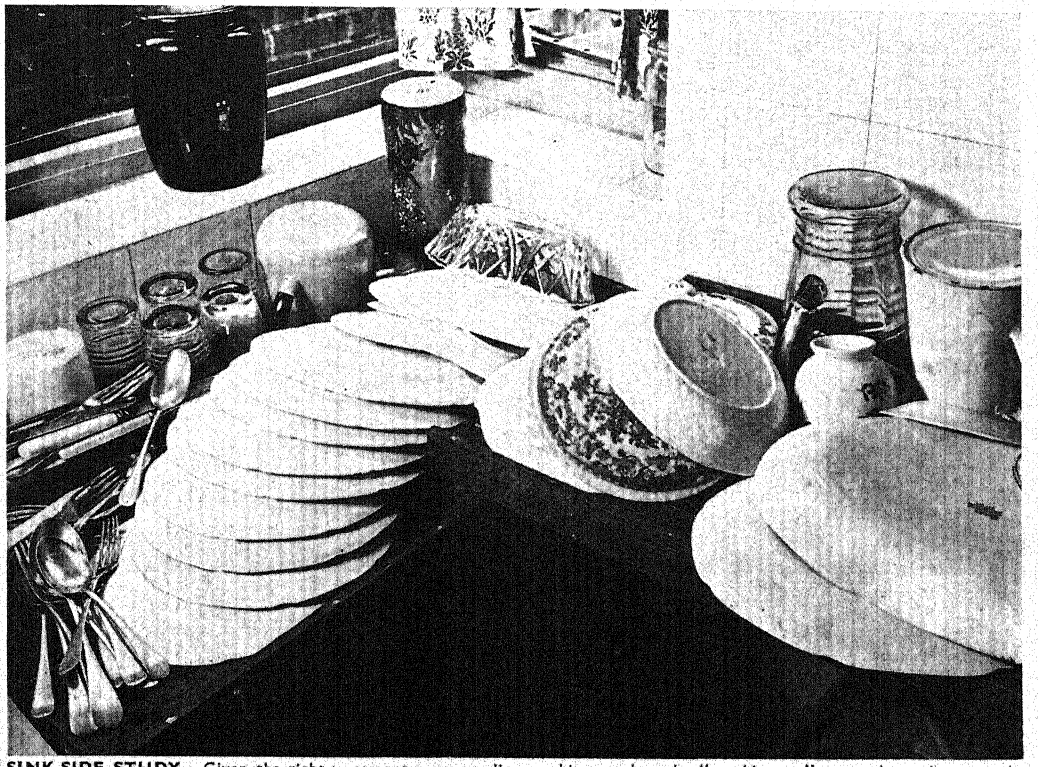
Copying. It is far more probable, however, that the subjects presented to him will include a set of testimonial letters, or some certificates or medals awarded to the products at exhibitions. The former will require careful technique for their satisfactory reproduction (*see* Copying), and the medals will also be found to present a number of differing problems, mainly of lighting. A satisfactory method of photographing such small metal objects is to lay them flat upon a box, and to use a camera-stand which allows the camera to point vertically downwards. A rough cone of tracing-paper or muslin arranged to fall from lens to around the box will usually overcome most of the lighting problems.

General Knowledge. Even the above will by no means exhaust the variety of types of subjects which a single factory or industry may expect the commercial photographer intelligently to handle. For instance, if it be one which uses horse-transport, he may be sure that a knowledge of the elementary points of animal photography will stand him in good stead if pictures of the transport department are required. To photograph a crowd of work-girls pouring out of the factory at the lunch-hour calls for emulation of the press-photographer's methods, and the same will hold good when the photographer is asked to take photographs of the visit of notabilities to the works, or the occasion when the factory team wins a cup. The photographer may find himself pitied if he fails to understand the technical language peculiar to every industry.

Qualifications. Thus the widely differing demands upon the services of a commercial photographer call for the qualities of intelligence and resource to an extent scarcely known in any other craft. And the work also calls for greater physical endurance than is popularly realized; it is far from well paid, and, therefore, does not attract many people of educational achievement.

The same applies to those employed as staff photographers to large concerns. Neither their status nor their remuneration is usually above that of a good mechanic. Yet they may be expected to add to their accomplishments, as described above, such additional requirements as the making of sets of lantern-slides, advertising studies of human models, the production of huge enlargements or photomontages for exhibition stands, and the colouring of the same; they may also be required to undertake the handling of various scientific instruments in which records of manufacturing tests are produced on photographic sensitive material, to say nothing of the making of blue-prints and allied duplications of workshop tracings. They may possibly be called into conference when the directors are considering investment in some new photographic invention.

Unusual but Frequent. The free-lance commercial photographer sometimes is asked to make, or to supply from stock, photographs of special but quite unusual character. The following are instances in the experience of the writer and some of his friends of such demands made in most cases with the apparent expectation of practically immediate supply: A rat, to be posed (when caught) in a particular attitude preconceived by the client. A factory with five tall chimneys, all of which must be smoking heavily. A bed-bug, greatly enlarged. Selection of fat babies. Some sticklebacks to be shown actually swimming, if possible with a newt. A Russian peasant family at tea. Pigs to be shown flying over London. A microscopic hole in the side of a drain-pipe at the bottom of a four-foot trench in a field. A ladder in a silk-stocking. More than half of these were actually supplied.



SINK-SIDE STUDY. Given the right treatment, a very ordinary subject, such as the "washing-up" scene shown here, can be made bright and interesting. Photographs with a domestic angle are extensively used for magazine illustration as well as for the purpose of advertising

Photo, Fox

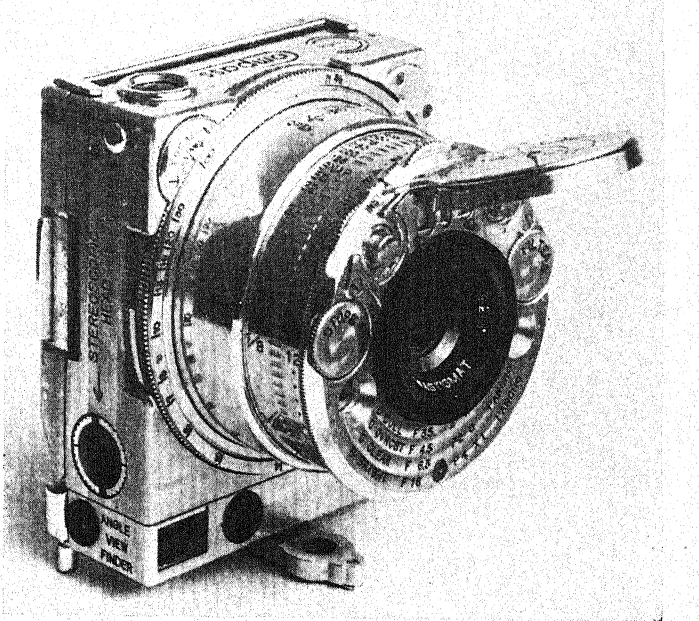
COMPASS CAMERA. A large proportion of the genuine miniature cameras on the British market are of foreign manufacture and origin, but the remarkable Compass camera introduced in 1937 is the product of the inventive genius of an Englishman, Mr. Noel Pemberton-Billing. It is covered by eight British patents, followed by world patents. It may reasonably claim to be the most original camera yet devised, for it possesses many features which are truly unique. First, it is the smallest of precision miniatures, measuring $2\frac{7}{8}$ in. deep by $2\frac{1}{4}$ in. wide and $1\frac{1}{4}$ in. thick (with the plate back in) —no larger than the surface area of a packet of cigarettes! Its weight is $7\frac{1}{4}$ ounces, and it goes easily into a waistcoat pocket or a lady's handbag.

Despite its smallness it is a genuine precision camera and a marvel of watchmaker's construction (it is made by Le Coultre Co., in Switzerland, since the minuteness of its design restricted its manufacture to watchmakers). It includes a wedge extinction exposure meter, a coupled range-finder, 3 Wratten colour filters, direct and right-angle view-finder—all built in. In addition it carries lens hood and lens cap engraved with depth of focus scales, spirit level, panoramic and stereoscopic heads, ground glass screen with magnifier adjustable to the individual sight, and a direct focussing scale from infinity to $1\frac{3}{4}$ feet. Obviously it leaves little room or need for the extra accessories that sometimes turn a miniature camera into a cumbersome burden.

The lens is a Kern *f*3.5 anastigmat of 35-mm. focal length, and it is therefore of the wide-angle class. Four stops, *f*3.5, *f*4.5, *f*6.3 and *f*16 (giving Compass factors of 0, 2, 4, and 8 respectively) are provided. An excellent shutter accurately speeded from $4\frac{1}{2}$ sec. to 1/500 sec. is provided with 22 different speeds in all (Compass factors 2 to 22). A plate back is fitted which is interchangeable with a special roll-film back (6 exposures). The size of the contact print picture is $1\frac{7}{16} \times \frac{15}{16}$ in.

An ingenious double scheme is provided whereby the " snapshot amateur " can take advantage of the camera's special qualities without troubling to adopt precision technique. The procedure is simple. Rotate the milled disk marked " Stops " until D, O, C or B appear in the circular window immediately below, these letters indicating " Dull," " Overcast," " Clear," or " Bright," *i.e.* weather conditions. The shutter speed ring is set with " Snap " opposite a small black arrow marked " Inst." and provided the disk marked " Filters " is set to show O in its circular window, there is nothing to do but focus (on ground glass screen or by the rangefinder), wind up the shutter and press the release stud at the top left corner (remembering always to pull out the collapsible lens hood). The shutter cannot be released unless the lens cap is lifted, thus avoiding the waste of unexposed plates.

The keen photographer will take full advantage of the precision equipment. The wedge extinction exposure meter slide is



COMPASS CAMERA. A miniature camera, weighing $7\frac{1}{4}$ ounces, with a lens of 35-mm. focus at *f*3.5, which focusses either by a range-finder scale or ground glass screen. The negatives are about $1\frac{1}{2}$ in. by 1 in., and the exposure meter is marked on the view-finder in conjunction with the shutter, stops and filters. A spirit level and a collapsible lens hood are built in. The photo shows the camera slightly less than actual size

pulled out until only high-lights are faintly visible) at least 20 seconds should be given to this operation in bright light to allow the eyes to become accustomed to the dimmed image if correct readings are to be obtained). This gives a factor—say, 6. The lens is used at full aperture giving a factor 0. The K1 ortho. or the G panchro. filter is rotated into position, either giving a factor of 2. An Ilford Hypersensitive plate (if used) gives a factor of −4. Thus 6 + 0 + 2 − 4 = 4. The small milled catch on the top left edge is wound over to show a red edge, and then the speed ring is rotated until the figure 4 is opposite the small black arrow. The speed ring is locked by closing the small milled catch. The red figure in line with the black figure 4 shows the shutter speed to be 1/125 sec. ("Snapshot" speed is 1/75 sec.) Focussing is effected by the use of the double-image range-finder, by inspection of the magnified image on the screen, or by direct measurement and the scale on the focussing screen. By these simple methods correct exposures are readily made.



FOCUSSING DETAILS. View of back of the Compass camera, showing the diminutive focussing screen with magnifier in position for viewing. Every component, though small, is very substantially made

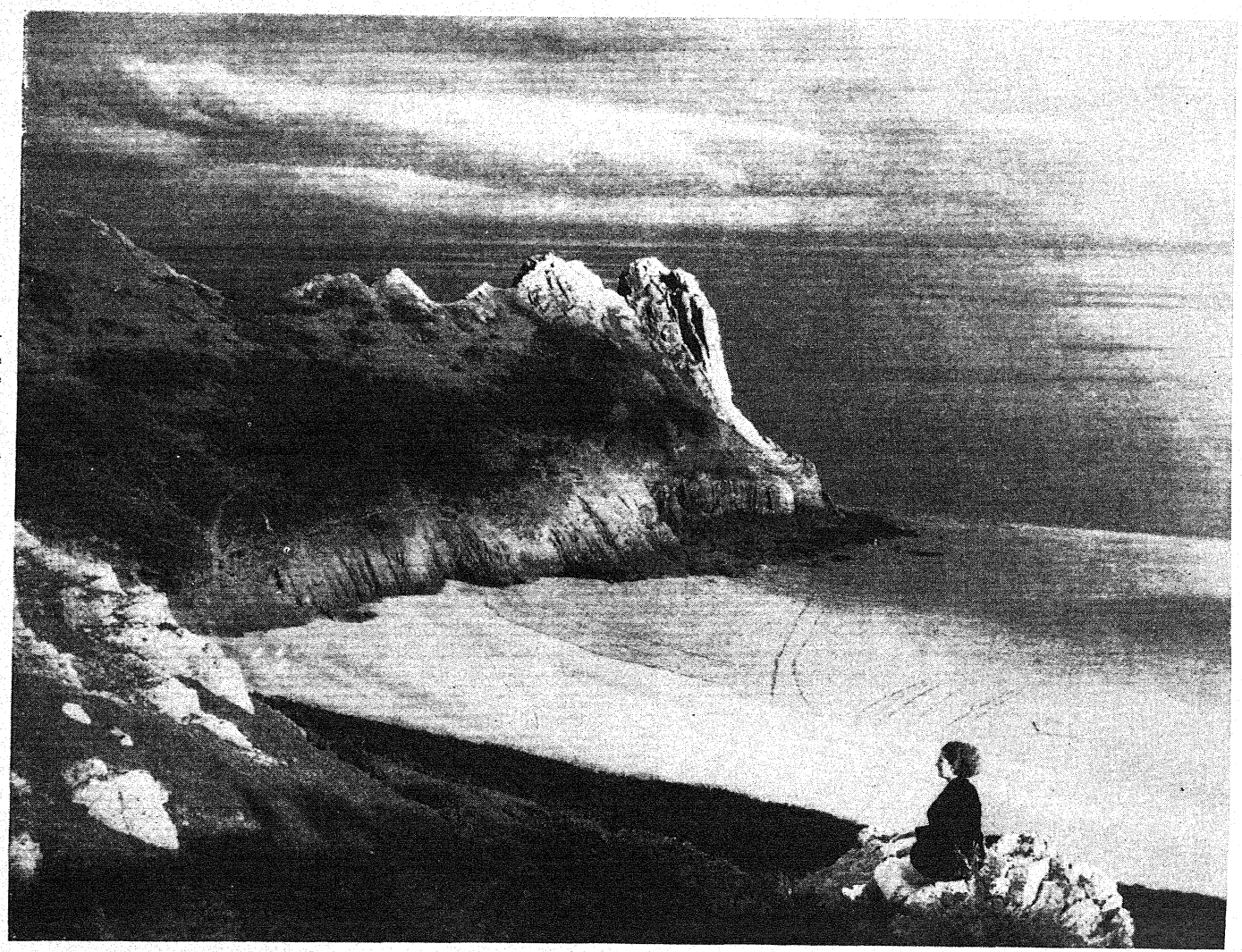


A MERE HANDFUL. This photograph gives a good idea of the remarkable compactness of the Compass camera. It weighs less than eight ounces, yet every essential accessory is built in as an integral part of the instrument

Special plates and roll-films are made for the Compass camera by Ilford, Ltd. The plates (23 × 36 mm.) are supplied in daylight-loading stiff paper envelopes with slides. A spring pressure back holds the plates firmly in their correct focal plane. A cleverly designed roll-film back permits the use of six exposure spools. In its use care must be taken to see that it is loaded exactly according to instructions so that the indicator (red star and figures) synchronizes precisely with the position of the film as it is exposed. Thus the camera offers either single exposures (plates) and as low as six for films—an attractive feature for those who do not wish to wait for 36 or more exposures to be completed before developing.

Two screwed heads sunk into the side of the camera body provide means for making continuous panoramas in five sections or for stereoscopic pairs of photographs, a tripod being then, of course, employed.

It would be impossible to imagine a camera of such quality which could be more complete in itself. It is most delicately precise and yet substantially constructed. Like a good watch it appears to possess capacities for prolonged hard wear. For examples of its photographic qualities reference should be made to reproductions of enlargements (with the tiny contact prints) given in earlier pages of this work, *e.g.* pages 9, 17, 39 and 56. The sharpness of detail should be especially noted.



THE GREAT TOR. A fine photograph of the famous Devonshire landmark obtained on a June evening during a brief gleam of sunshine

Photo, R. C. Hughes; f16, 1/10 sec., Kodak S.S. Pan. film; prize-winner in the "Modern Encyclopedia of Photography" Competition

COMPETITIONS FOR THE AMATEUR PHOTOGRAPHER

F. J. Mortimer, Hon. F.R.P.S.

Editor of ' The Amateur Photographer ' and ' Photograms of the Year '

The amateur photographer who has attained some skill with his camera and who has developed the " photographic sense " can find an additional attraction to his hobby in the numerous photographic competitions that are frequently organized. Here the different types of contest are discussed and advice is given to the prospective entrant

See also Exhibitions

A NOTABLE factor that has indirectly affected modern photography is the great increase in the number of prize competitions for amateurs. Competitions organized by photographic journals for the benefit of their readers have been held in a small way almost from the beginning of photography, but the development referred to has grown into a much bigger thing today.

These competitions, in addition to those held by photographic papers, have been organized by (*a*) firms supplying photographic materials, (*b*) firms seeking the best photographs to illustrate their products which are not photographic, (*c*) towns and holiday resorts who wish to encourage photography of their beauty spots to attract visitors and for propaganda purposes, and (*d*) competitions organized by daily and weekly newspapers, either for the best prints sent in irrespective of subject, or to illustrate some specific aspect of life.

Appeal of Competitions

The last-named competitions have probably been the biggest and most widespread during the past few years, and the cash prizes in some cases have been almost fantastic, but the results appear to have satisfied the organizers, and the competitions have not only helped to create a greater interest in amateur photography, but have been the direct cause of thousands of photographs that would not otherwise have been made.

The appeal has been in each case to the competitive spirit, which actuates any follower of a particular hobby who is always anxious to do something better than his neighbour, and if his efforts produce a pecuniary reward in the shape of a prize, the inducement is even greater.

These competitions have, in addition to encouraging photography generally, also helped to raise its standard in certain directions, and there is little doubt that they are, on the whole, a very definite incentive for making better photographs. There are many thousands of amateur photographers, however, who, in these competitions, have the idea that any sort of print will do. This error is eventually brought home to the participant by the fact that his name never appears in the awards lists.

The winning pictures in nearly every case are fine photographic productions, in spite of the statement made in many of the more popular competitions organized by the general press that technical skill does not count. The fact remains that, other things being equal, such as pictorial quality and suitable subject material, the best technically produced prints are the ones that win every time. This is because, in view of the enormous number sent in, it is necessary to present the subject as well as it can be done photographically if it is to make any appeal to the judges at all. A bad technical print nullifies whatever other good qualities it may possess. There is no reason, however, why bad prints should ever be sent in to competitions, but there are always many that are obviously carelessly made and full of faults.

First Essentials

From this it will be gathered that to succeed in winning prizes in photographic competitions the best prints that can be made by the worker should always be submitted, and in addition certain other points should be borne in mind, and these apply both to beginners and advanced workers, although the latter are less likely to make mistakes than the former.

The points to remember are : In preparing for entering such competitions the first thing to study is the rules and conditions, so that the clearest idea can be obtained of what

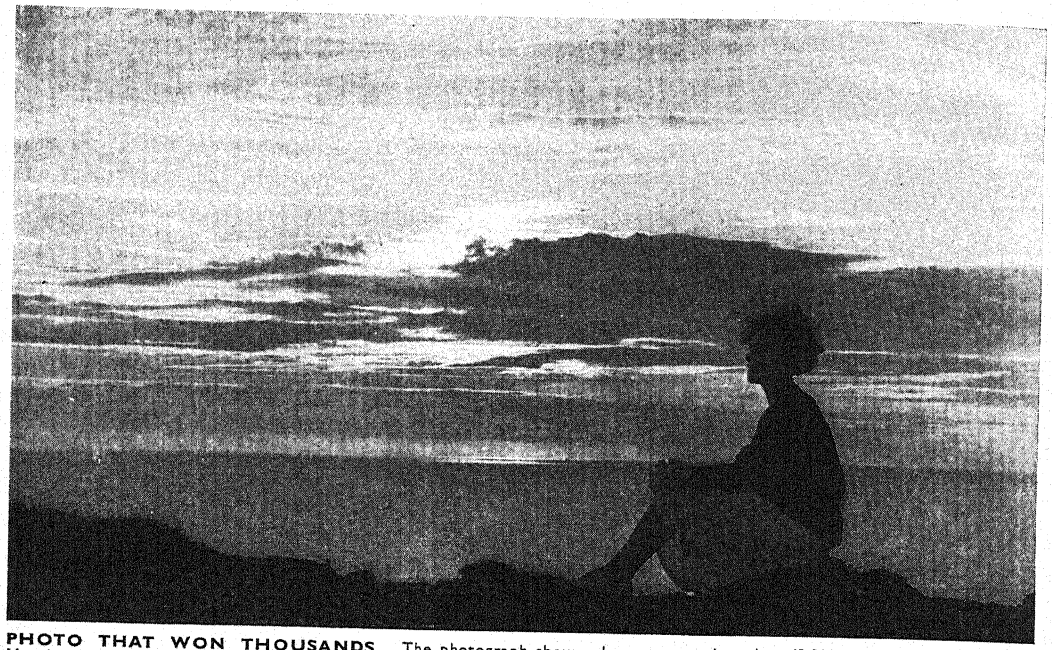
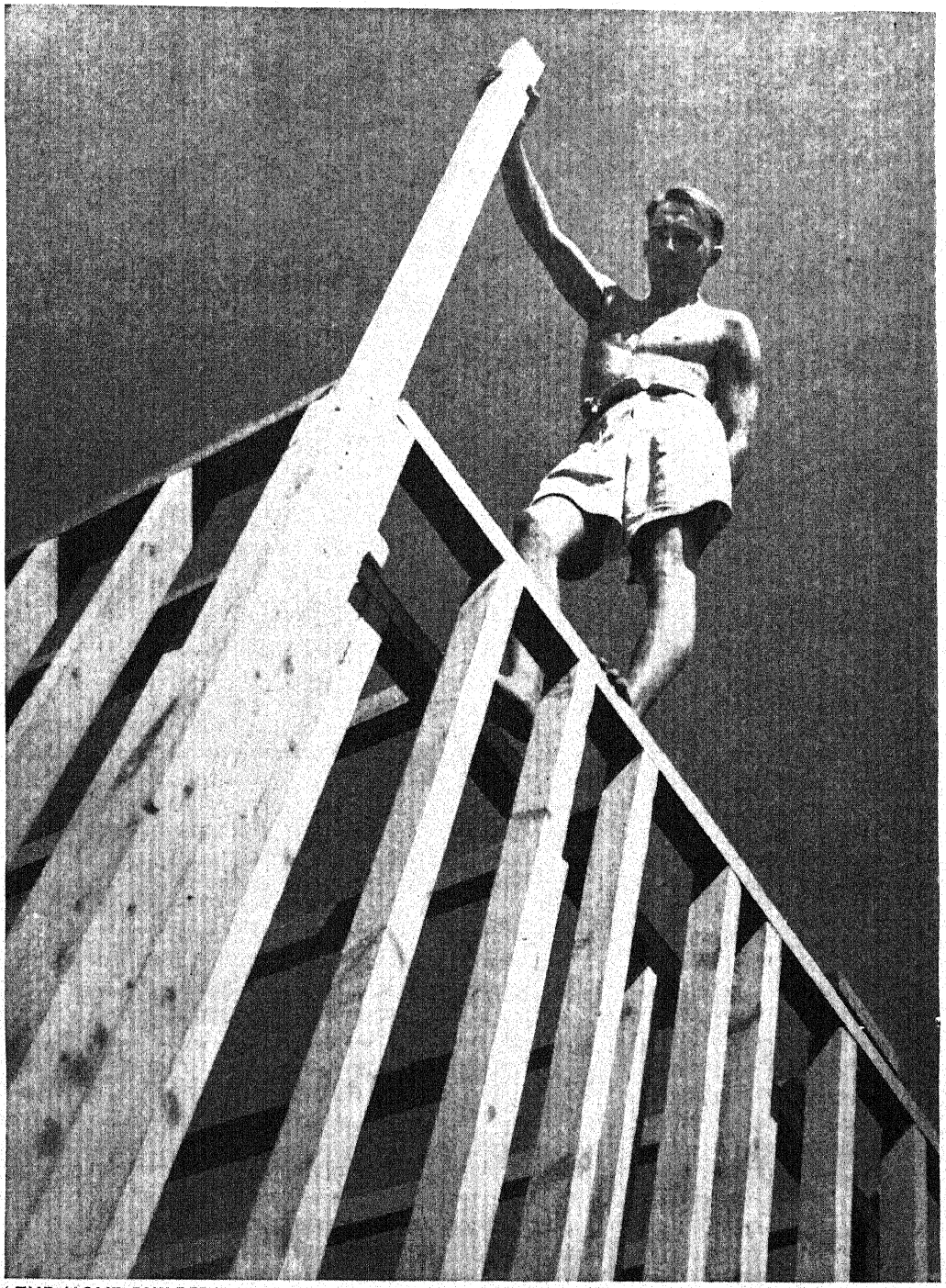


PHOTO THAT WON THOUSANDS. The photograph shown above won no less than £3,300 for Charles E. Powell of Manchester in a world-wide competition organized by Kodak, Ltd., in 1931. The sum awarded and the simplicity of the picture, which was judged solely on general appeal, show how great are the possibilities for the amateur in competition work with quite modest apparatus

Kodak Snapshot



JUDGES' CHOICE. Here are two further examples of photographs that won prizes for entrants in photographic contests. Left, first prizewinner in Boots' " Spirit of the Coronation " competition best fulfilled the requirements laid down in the conditions. Right, the second prizewinner in the " Daily Herald " 1936 £2,000 Competition. The judges included Mr. F. J. Mortimer, Dr. D. A. Spencer, Messrs. E. Blake (Managing Director of Kodak, Ltd.), E. W. Houghton (Chairman, Ensign, Ltd.), T. Illingworth (Ilford, Ltd.), L. Spooner (" Daily Herald ") and A. Hitchcock (Gaumont-British)



'THE HOME BUILDER.' Novelty arising from the unusual viewpoint, fine tonal harmony and an admirable impression of texture are outstanding qualities of this prizewinning photograph entered in the "Modern Encyclopedia of Photography Competition." Photo by R. Douglas Paul, Hampstead, N.W.3.

1/100 sec. *at f/16, Kodak Panatomic film, light yellow filter*

the competition is about, and exactly the sort of thing that the organizers want. If, for instance, the subject is " Beautiful Britain," the prints submitted must definitely represent some beauty spot or some beautiful setting, landscape or architecture, connected with a place in Britain. Portraits, no matter how good, therefore, would be quite unsuitable, although there is no reason why animals or figures should not be included in pictures of well-known beauty spots. In every competition there are always hundreds of prints that show that the senders have never taken the trouble to read the rules—yet they expect to win a prize.

Choice of Subject

The second thing, when pictures from the competitions are reproduced from time to time before the final date, is to study the reproductions, so that some guide can be obtained as to the class of subject and the treatment of it that appeal to the judges.

When the clearest idea of what is required has thus been obtained the worker can then set out, either with the deliberate intention of photographing subjects he thinks will be suitable for the particular competition, or search through negatives he already has to find similar subjects. The very best print that the negative will give must be made, and if the negatives are small the prints should be enlarged, at least to whole-plate size, and preferably on glossy or " velvet " surface paper. These rules particularly apply to newspaper competitions, as glossy prints will be more suitable for reproduction in the press. For this reason they should be clean and bright. A fuzzy print, on a dull surface paper, even of a good pictorial subject, will, as a rule, stand a poor chance.

If the competition is for a specific subject, as mentioned above, the choice of material is limited, and there is no reason whatever for the competitor to depart from the subject indicated. When, however, the subject is more general in character, as, for instance, with abstract subjects such as " Summertime," or " Happy Days," or " New Angle Shots," there is a wider range of material available, and the range becomes even greater still when the prizes are offered for the best " pictorial prints " only, without reference to subject.

For newspaper competitions the " human element" must definitely predominate unless the subject is frankly for landscape or architectural or animal subjects, when there is a limited choice. In every other case the "human element" should play a very strong part in the subject material. This means the inclusion of one or more figures, which are definitely part of the composition, and the figure should be engaged in some occupation or doing anything but staring into the camera. The only occasion on which this is permissible is when the subject is a large scale portrait, or something akin, such as pictures of " bathing beauties." In all other cases an endeavour should be made to render the photograph in such a way as to make the person appear unconscious of the presence of the camera. Attention should be paid to the foreground, which should be strong and always sharp in detail. The picture should concentrate on one definite subject only, otherwise the composition will be scattered.

Importance of Fresh Ideas

The next thing to observe is to keep a note of such pictures that have already appeared in the competition, and to aim at originality. Nothing is more boring to the judges of these competitions than to have twenty or even a hundred prints, all representing the same popular idea, and all treated in more or less the same way. All the prints may be good, fine technical pieces of work, and with pictorial quality, but the fact that they lack originality in all dealing with the same subject in the same way may result in the entire batch being rejected. Originality should therefore be aimed at, both in the choice of subject material and in its treatment. There should be no difficulty in this—even with the most familiar of holiday snapshots. The worker with original ideas can always find a new viewpoint, or take the subject from a new angle, or select only a part of the negative and enlarge that instead of the whole subject as originally seen.

Many competitions are divided into two sections, one for beginners and one for advanced workers. Here, as a rule, greater leniency is given to the beginner class and more consideration afforded to obvious novices' mistakes. At the same time, even the beginner should still endeavour to make

the best possible print—and above all see that it is trimmed correctly with straight edges and right-angle corners and neatly mounted. A badly trimmed print—or a carelessly mounted one—with finger-marks in evidence, will severely handicap it, no matter how good it may otherwise be.

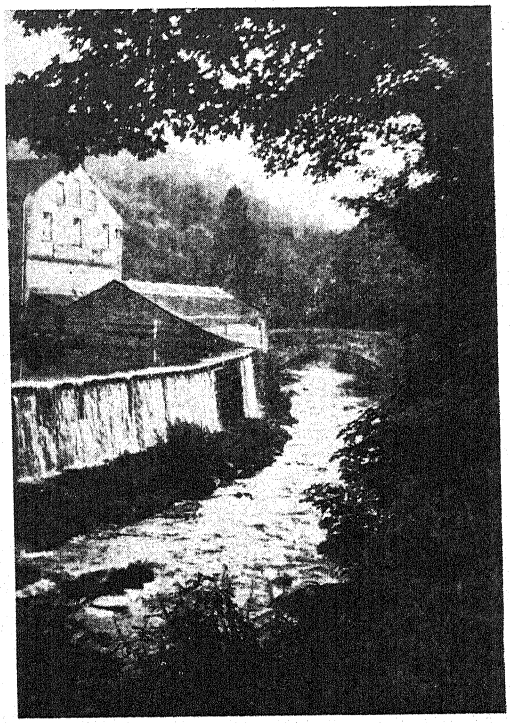
Small Items that Count

With advanced workers these matters may not need to be impressed, but they are equally important, and it will generally be found that the winning prints in the big competitions are not only good both pictorially and technically, but are also well "presented." It is in these small but important details that the best workers keep on top, and they are not beyond the capabilities of any amateur who cares to take a little trouble.

Many the same general principles apply to the other kinds of competitions mentioned above. When, for instance, the prizes are for the best work done with certain apparatus or materials, such as miniature cameras, films, papers, developers or flash powders, etc., the good points claimed by that apparatus or material should be emphasized apart from the subject matter.

When the prizes are for illustrating some particular district, the locality shown in the pictures should be clearly recognizable, but it will be well to avoid the obvious and well-known points of view. When visiting a resort with such a competition in view—the picture postcards and illustrated guide books of the district should be obtained and studied. The places depicted should be visited and viewed from all angles, and every endeavour made to avoid taking the same subject in the same way, but to find new points of view. Here, again, the originality of the worker will have a chance of being exercised, and a familiar spot photographed in a new way or from a different angle will stand a much greater chance of being noticed by the judges than the usual hackneyed view, no matter how well it is done.

The competitions that are organized from time to time for photographs of specific subjects give the worker a chance of exercising his creative instincts in making attractive compositions. The subjects may be for toilet goods, such as perfume, etc., shoes or foods; in any case great possibilities are presented if the "human element" is introduced effectively. Clear glossy prints are also best in this case.



PLEASING LANDSCAPE. The composition is particularly successful as the lighting contrasts, the large masses, and the detail have all been nicely balanced. The photograph was taken at 4.30 p.m. in September, at Gibson Mill, Hardcastle Crags, Hebden Bridge, Yorks.

Photo, G. H. Birch; Verichrome film, 1/25 sec. Prizewinning print, "Modern Encyclopedia of Photography" competition

Competitions in photographic journals are usually for the encouragement of their readers to make better negatives and prints, and even when special subjects are set the prizes will go to the photographs that show the greatest technical and pictorial quality in addition to originality of treatment of the subject.

In these competitions it is not necessary to make the prints—as with newspaper competitions—on glossy or "velvet" paper—any type of print is generally admissible, but the best must be made of the printing process employed, and the same attention paid to careful trimming and mounting. If the pictures are titled, the lettering should be done as neatly and unobtrusively as possible. When required, the necessary coupons should be stuck on the back of the print and the full name and address also written on every print as a means of identification.

COMPOSITION IN PHOTOGRAPHY

W. L. F. Wastell, Hon. F.R.P.S.
Past President R.P.S.

The proper grouping of materials in photographic reproduction is one of the many factors that must be considered by every serious photographer, for without an understanding of the principles of composition his work must fail from the artistic standpoint. Here is an article which serves as a valuable guide to all camera users who seek improvement in their pictorial technique

See also Art in Photography ; Beginners, Hints and Tips

THE word " composition " was originally used in reference to the manner in which painters " composed " a picture by bringing together various elements, such as natural objects, architecture and figures, so as to produce a " subject." The result was a good composition—or otherwise. To the photographer the word has a more restricted meaning. With a few exceptions, such as the selection and arrangement of a still-life subject, or of figures and accessories for a group or a *genre* picture, he is restricted to things as they are.

In the main he must rely, for most of his subjects, on the selection of material, on the viewpoint from which he records it, and on the modifications in effect resulting from lighting and atmosphere. These alone provide him with considerable scope and freedom, and he cannot take full advantage of his opportunities unless he applies, consciously or intuitively, certain ideas as to the composition of his subject. This means, fundamentally, the best selection and arrangement of the material for the purpose in view.

" Mere technical correctness in composition will avail nothing," said J. D. Harding. Certainly a photograph may disclose no noticeable faults in composition and yet be a poor thing, just as perfectly grammatical writing may make very dull reading. But no merits of a picture can condone serious faults in selection and arrangement.

Nothing Intruding, Nothing Lacking

To get complete pleasure and satisfaction from a print we must feel " that all is right and nothing wrong." We must not feel that anything is an intrusion, or that some essential is lacking ; we must not feel that we should like to move this or modify that.

Among different peoples, and at various times there are changes in the style of graphic art just as there are in costume, and we need consider here only some of the principles of photographic composition which are more or less recognized and practised by the best workers. Most of these principles are based on psychological effects, and if these are understood it will be some guide to the conditions under which the principles may be observed, modified or ignored.

' Laws ' of Composition

Photographers are often advised to get ideas of composition, in every sense of the word, by studying the work of painters. Unless this is done with discretion the study may do more harm than good. Many painters made such a fetish of the " laws " of composition that they constructed pictures to formulae, the results being conventional, artificial, and often painfully ridiculous. The best pictures by any medium do not advertise the fact that they have been carefully composed ; they are naturally and spontaneously right. Hence the wise saying, *Ars est celare artem*—true art is to conceal art.

If we study and compare the photographs which please and satisfy us most we begin to recognize certain common factors. It becomes evident that there are definite means of securing such things as centre of interest, harmony, balance, mood and so on. Upon these common factors we base our so-called " laws " of composition.

It may be well to consider an example of the psychological effect already mentioned. We naturally expect that we shall be able to understand the aim or purpose of the photographer in making a given picture ; he should not leave us in doubt. Yet he too often does.

As an instance, take the familiar subject of a landscape with a single figure.

The landscape may be beautiful, interesting and well arranged ; the figure is

appropriate to its surroundings, well placed in the picture-space, and although adding a note of interest, is definitely subordinated to the landscape. This is obviously a landscape with an incidental figure.

Again, the figure might be on a much larger scale, dominating the landscape—now of a simple and unobtrusive character. This is obviously a figure subject or portrait in a landscape setting.

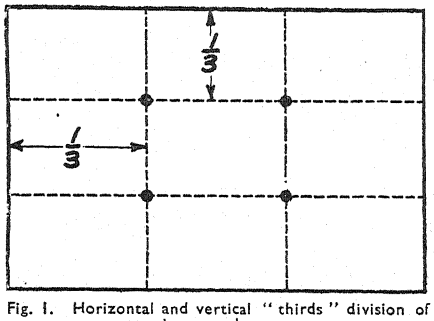


Fig. 1. Horizontal and vertical "thirds" division of picture and space

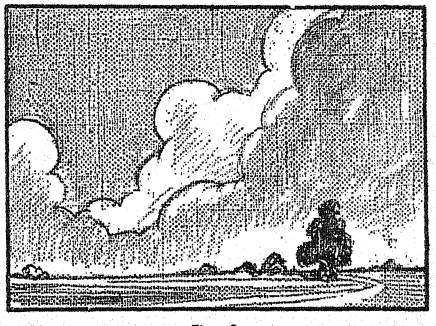
Either of these treatments might be quite satisfactory, and we should be in no doubt as to the intention. But the figure and the landscape might be presented in such a way that our attention is equally divided between the two. We cannot look at one without being distracted by the other. It is neither a landscape with figure nor a figure with landscape; and the mental irritation and uncertainty thus occasioned justifies us in condemning the composition. It offends against the compositional "law of principality."

Similarly, we mentally resent compositions that are lop-sided, top-heavy, overcrowded, confused, vague, empty, formal, and so forth.

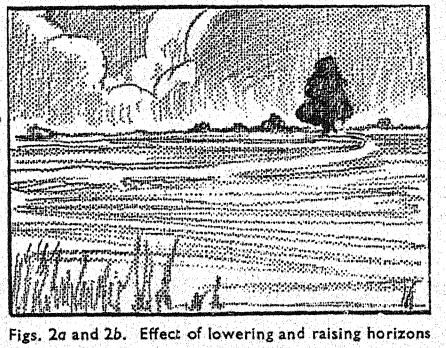
In much technical and record photography the work is mainly a question of craftsmanship, and composition plays but a small part. A single object such as an article of jewelry or a carved panel would merely require placing in a picture-space proportionate to its dimensions, with suitable equal margins at top and sides, and a rather wider one below. The case of a portrait head would demand more consideration. A full-face view might be centred laterally but above the centre vertically; a profile rendering would require more space in front of the head than behind it.

The more "pictorial" the work the greater the care required in its composition. In the days of the stand camera it was suggested that compositional salvation could be achieved by ruling the focussing screen into sections which were invested with varying degrees of "strength."

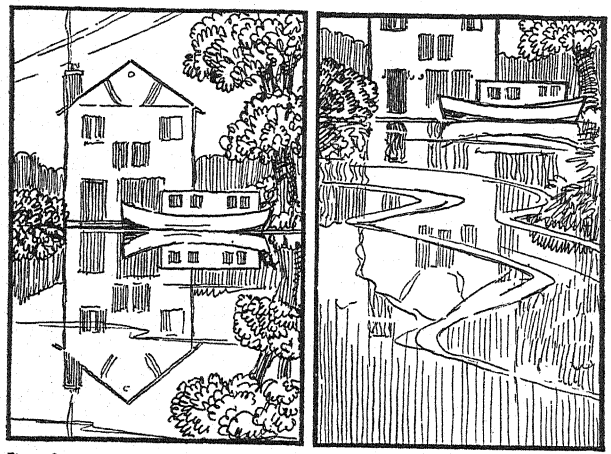
The matter is not so simple and mechanical as that; but it is a help to visualize the picture-space divided into nine equal rectangles as in Fig. 1. The dividing lines have four points of intersection as shown, and it is often found that the main object or mass is best placed about one of these points, while a secondary balancing mass may fall on one of the opposite points. In unsymmetrical compositions it is a general rule that the principal object should not be in the middle of the picture-space, but near it; and it is evident that any such position will be near one of the four points of intersection.


Fig. 2a

Further, the horizontal "thirds" suggest approximate positions for the horizon line, visible or imaginary. A level camera causes the horizon line to bisect the picture, and this equal division of the space is generally unsatisfactory; hence the camera must be tilted up or down, when this is permissible, or when this is not possible the rising and falling front must be used.


Figs. 2a and 2b. Effect of lowering and raising horizons

In Fig. 2a the horizon has been lowered; while in Fig. 2b it has been raised. When the sky is intended to be the



Figs. 3*a* and 3*b*. Repetition effects, equal and unequal; note improved pictorial effect of latter

What is called "repetition" (of form or line) is often a useful feature, but at times it is irritating. In Fig. 3*a* the repetition is the result of mirror-like reflections; and as the picture-space is equally divided the upper and lower parts make practically the same claim on the attention. The result may be curious and interesting, but is too formal and balanced and not satisfactory pictorially.

In Fig. 3*b* the now broken reflections are given pride of place by raising the horizon, while sufficient of the actual objects has been retained to make the total effect both realistic and natural.

more important feature it should be allotted the larger portion of space; and the reverse should be the case when it is the landscape that is to claim attention. If the spaces were equal it would suggest that landscape and sky were of equal significance, and there would be equal division of interest as well as of space. It may be noted that in Fig 2*a* the rise in contour formed by the largest tree is imitated by a rise in the mass of cloud above; it would be better if the clouds rose up towards the left instead of the right. If it be argued that the clouds were on the right, the answer is simple. Change the viewpoint or wait for the clouds to move, or both, and in any case the result will have natural charm.



Fig. 4*a*. How to avoid the formal straight-on-view of Fig. 4*b*

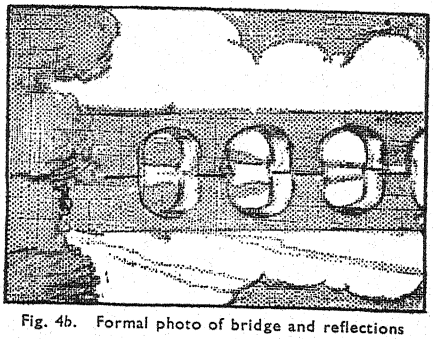


Fig. 4*b*. Formal photo of bridge and reflections

Different means have been adopted in Fig. 4*a* to give a glimpse of the bridge and its reflections, in conjunction with the tree and foreground, so as to avoid the rather rigid and formal rendering which is shown in Fig. 4*b*.

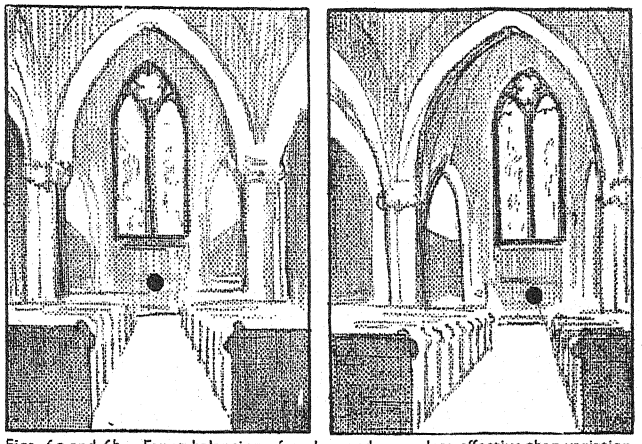
Still more formal is the view of the cottage in Fig. 5*a*, which, incidentally, is too crowded in the picture-space. It is, of course, a good record of the front elevation of the building, and as such has some architectural interest; but it is not in the least pictorial, and has no suggestion of good composition and hardly even of a third dimension. A change in viewpoint, which is usually easy to effect, and a lowering of the horizon give the version in Fig. 5*b*. This

Figs. 5*a* and 5*b*. With and without composition contro





may not be so satisfactory for showing the construction and detail of the cottage, but it is far better as a picture. It carries a suggestion not so much of one particular cottage as of many similar buildings; and it is always a good thing if we can so select and compose our subjects that they arouse pleasant memories.



Figs. 6c and 6b. Exact balancing of arches and pews less effective than variation. Black spot is vanishing point in perspective

The symmetrical arrangement of Fig. 6*a* is not so objectionable, as the character of the subject to some extent justifies it; but Fig. 6*b* is preferable. The balanced design of the building is still evident, but there is more variety in the direction of the lines. Such a difference is made merely by shifting the line of sight. What is known as the vanishing point in the perspective is indicated by the black dot in each case. In 6*a* it is equidistant from the sides; in 6*b* it lies on one of the intersections of thirds.

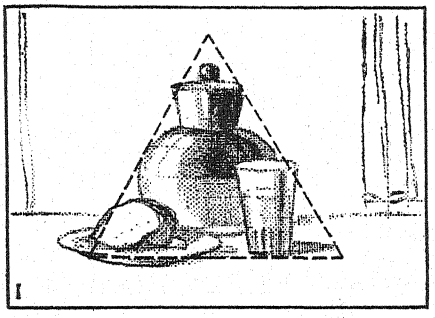


Fig. 7a

gests firmness and stability. In Fig. 7*a* the objects are too central, and are cramped by being compressed within an equilateral triangle. The same objects in Fig. 7*b* are roughly enclosed in a scalene triangle, and the pyramidal arrangement, although distinctly present, is not so obvious.

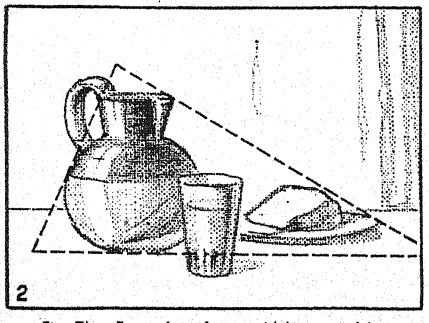
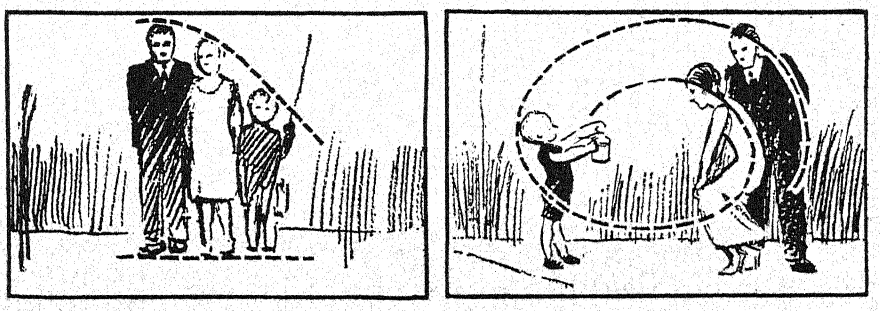


Fig. 7b. Examples of pyramidal composition

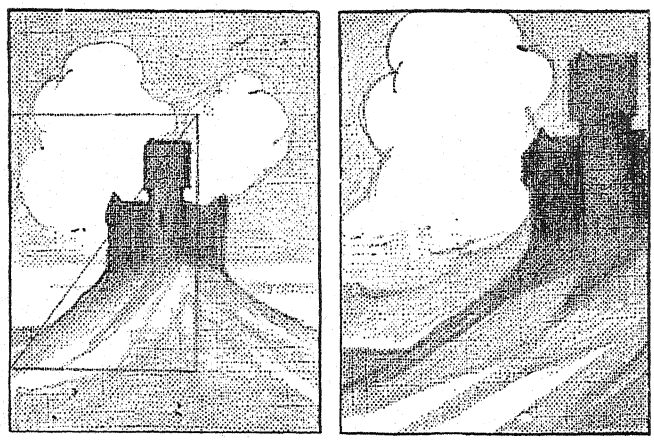
The Pyramid and Other Forms

Various forms of composition have been given significant names according to their general characteristics—pyramidal or triangular, circular, diagonal, etc. Figs. 7*a* and 7*b* are examples of pyramidal composition—a form which generally suggests firmness and stability. In Fig. 7*a* the objects are too central, and are cramped by being compressed within an equilateral triangle. The same objects in Fig. 7*b* are roughly enclosed in a scalene triangle, and the pyramidal arrangement, although distinctly present, is not so obvious.

Absurd as is the placing of the three persons in Fig. 8*a*, it is rather the truth than a caricature of examples turned out by inexperienced photographers. Its faults are obvious. In Fig. 8*b* the placing and attitudes of the same three persons suggest a sweeping spiral arrangement as indicated by the dotted line. When the word "line" is used it does not necessarily mean an actual line. In Fig. 8*a* there is no line along



Figs. 8a and 8b. Obviously bad and good poses



Figs. 9*a* and 9*b*. Pyramidal and diagonal composition contrasted

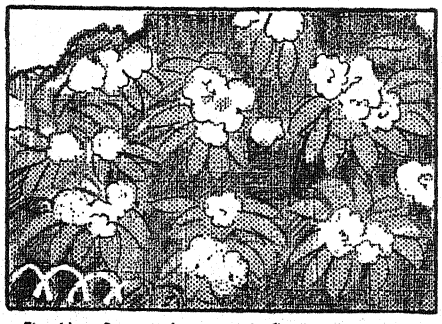


Fig. 11*a*. Scattered interest in flower photograph



Fig. 11*b*. The remedy by selection and simplifying

the feet, but it is clearly suggested; so also is the line indicated by the position of the three heads. Similarly the triangle in Fig. 7*b* is "felt," not seen.

Although the castle in Fig. 9*a* is very strongly placed, and of pyramidal arrangement, it is too formal for such a subject, and it has been modified as shown by the smaller rectangle with its diagonal. In the result shown in Fig. 9*b* the diagonal composition is clearly seen. It is evident again in Fig. 11*b*.

Modification of the composition by trimming the print or excluding parts of the negative is a very valuable possibility, and we should always be awake to it. If there were strong interest in the rutty road in Fig. 10 the arrangement might be appropriate; otherwise such restriction as is indicated by the dotted rectangle is an improvement. Note, as one detail, how one of the vertical thirds now runs through the mass of the two trees.

Scattered interest in the rendering of Fig. 11*a* has been remedied in Fig. 11*b* by selective simplification. In the amended version the composition combines two types. It is diagonal because the flowers are on or beside a line joining two corners; and it is evidently also triangular. Moreover, the elimination of several motifs in what is, after all, a repetitive pattern, has made the composition more powerful.

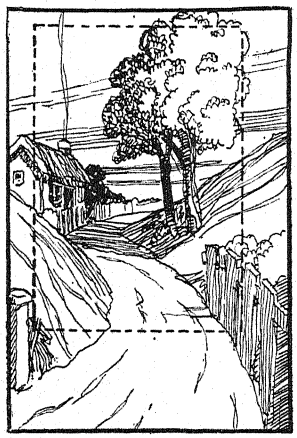
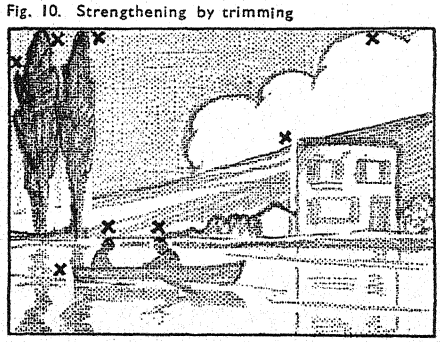
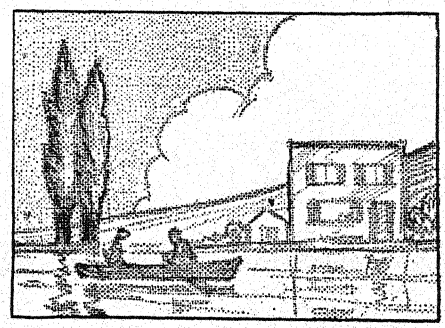


Fig. 10. Strengthening by trimming

A common fault in composition is illustrated in Figs. 12*a* and 12*b*. At each of the crosses in Fig. 12*a* will be found an awkward "contact." The stern of the boat is in





Figs. 12*a* and 12*b*. Points of awkward contact (marked by X) and how to avoid them

alinement with the reflection of a tree; a corner of the house just touches the line of the hill; and so on. In the second version shown on page 424 all these faults are avoided.

The simple examples given merely touch the fringe of the subject of composition, but they indicate some of the points that must be watched. In advanced work all sorts of subtleties and complications arise; and it is necessary for the serious worker to study and analyse pictures closely and carefully, so as to learn to identify their faults and to recognize their merits. It is a fascinating study and well repays the time and trouble devoted to it.

CONDENSERS. An ideal condition for enlarging and for all other forms of projection is a small though adequate—or even powerful—light source. Yet it is still necessary to secure even illumination, and so we are confronted with the problem of how to obtain an image in which the edges are just as strongly illuminated as the centre.

The solution is the double plano-convex condenser. This is used in preference to the single " bull's-eye," because the latter gives only a scattered and quite unsuitable beam. And the most expensive treble condenser, while offering few marked practical advantages, is actually inferior to the double plano-convex type, in that its use is accompanied by a much greater light-loss.

Adjustability. One of the greatest points about any condenser is its need for being freely adaptable in respect of its distance from the enlarger or projector legs. This adaptability is essential, since the highest degree of efficiency can prevail only where the condenser beam is brought to a focus actually within the objective lens of the instrument. Here the position of this lens is constantly being altered in order to effect the focus of different images, hence the necessity for these adjustments.

The modern tendency is, however, to keep the condenser permanently fixed and to focus the beam by varying the position of the light itself. In actual practice the operation is commenced by placing the negative in the carrier and focussing the image upon a suitable surface. Then the carrier is withdrawn, and the clear beam of light is made to project with maximum (even) brilliancy upon the screen. When this effect is achieved, it may be understood that the beam itself is brought to a focus within the objective lens, whereupon the carrier may be replaced and final critical focussing carried out.

In the case of cinematographs, provision for this adaptability is not always made. This is because the nature and assembly of the optical systems embraced do not suffer any appreciable effects of this deficiency.

Condenser Sizes. Condensers are usually purchased complete in the mounted state, and it must be observed that the effective surface of the accessory is no greater than that part which is visible to the eye. It is obvious, then, that no portion of the image it is required to enlarge should overlap the limits of the condenser.

An easy way to ascertain the diameter of condenser necessary to " cover " a negative or transparency of any size is to measure the diagonal. It will be found that the diagonal of a $3\frac{1}{2} \times 2\frac{1}{2}$ in. negative is slightly greater than $4\frac{1}{4}$ in., indicating that a condenser of $4\frac{1}{2}$ in. in diameter is required. Similarly, the quarter-plate, having a diagonal of approximately $5\frac{1}{3}$ in., would require a condenser with a diameter of $5\frac{1}{2}$ in.

It is not suggested that these sizes are absolutely necessary for use with the standards referred to. It may, and very often does, happen that the portion of the original negative selected for enlargement is well covered by a condenser of smaller size. But it is always better to be equipped for enlarging the whole of the negative image.

Condenser Care. As—except in cases where reflected light is used—the condenser is situated directly between the light source and the carrier, its exposure to the risk of accident is very real and apparent. On the one side there is the heat and all its attendant evils of moisture condensation and uneven expansion; on the other there is frequently a risk of scratching or other damage arising from the constant insertion and withdrawal of the carrier.

Cine enthusiasts are, of course, spared the annoyance of the latter, but their share of the former trouble is always much greater than " still " workers appreciate. Nowadays, it is customary to assemble the component parts of the condenser very loosely within their mount, and this almost completely

›viates one annoyance—that of splitting or 'acking.

Cinematograph condensers, by the way, 'e comparatively tiny things, and owing › their smaller mass they are considerably ss likely to suffer from steaming due to ›ndensed moisture. In this case—and, ıdeed, in all other cases—it may be advisable ɛfore touching the condenser to observe hether the peculiar " mottling " seen on ıe screen is not due to an accidental breath-ıg upon the more exposed objective lens of ıe instrument concerned.

The most troublesome defect, " steaming," due to condensation of warm moisture resent in the atmosphere upon the cold ırfaces of the glass components. It cannot ccur without the presence of heat in the ›om ; and it cannot occur unless the con-enser is really cold.

In the enlarging room—which, so far as ıost amateurs are concerned, is often chill nd cold, save in summer—the warm mois-ure is usually created by the lamp. This, whether it be of spirit vapour or one of the ıtest gas filled electric bulbs, is certain to enerate an appreciable amount of heat ; nd this, unfortunately, affects the moisture ›efore it can raise the temperature of the ›ondenser to safety point.

To remedy the trouble, all that is necessary is to remove the tiny spots of moisture from the affected surfaces. When these are on the flat sides of the ordinary double-plano-convex assembly, removal is quite an easy matter, but more frequently the trouble affects the inside surfaces. In such cases it will be necessary to remove the components and take up the moisture with a warm cloth ; and to prevent a recurrence of the trouble it is advisable before reassembling the components to heat them carefully until they no longer " steam " on being lightly breathed upon.

Picture Shows. Lantern and cine shows are not, of course, usually given in cold apartments. But it is quite common for the instruments to be kept in a cold store-room and brought out into the warmth only a short time before the commencement of displays. Obviously, then, the condenser will still be cold and susceptible to all the usual troubles. It should be kept in a warm room (if not the actual projection " theatre ") for at least an hour or so before the display is timed to commence.

Other Notes. Cracking and splitting of the condenser components occur only when the illuminant employed is capable of quickly generating great quantities of heat. It is then that the sudden change from a low temperature to an abnormally high one proves too much for the poor conductivity of the glass—with the result that cracking, chipping and more serious breakages may occur. Incidentally, the same troubles have been known to occur after use, when the highly heated instrument may be returned to rest in an ice-cold store-room.

It is significant that the condensers most affected by this trouble are those fitted to lantern and cine apparatus—where the temperatures developed are extremely high ; and in both cases it is the back component rather than the front which is more apt to sustain injury. Since the components concerned can be purchased at prices as low as half a crown each, it is worth while to carry a " spare " in case the inevitable accident occurs during an important display.

Slightly cracked or chipped condensers need not, however, be discarded. They may remain in use without detriment, provided that the chipped or cracked edge of the component is arranged to face the illuminant. And even where a slight image of the defect is thrown, this can be eliminated by using a ground-glass diffuser in the enlarger itself.

Troubles like steaming and breakage can also affect the fluid condensers familiarly seen on instruments of an obsolete pattern. Such instruments are still in use, however, and similar methods to those already discussed must be employed to overcome the troubles to which they are subject. With regard to freezing of the liquid, this is a special difficulty with which modern instruments happily do not have to cope ; but it can be overcome by immersing the whole condenser in warm water, or (what is better still) completely prevented from arising merely by the addition of a little glycerin to the original water.

Cleaning the condenser surfaces is occa sionally necessary, and in any case it has to be attempted whenever steaming occurs. Here special care is necessary to avoid scratching the component lenses with

unsuitable cleaning materials. A soft leather (chamois skin) is very useful in such contingencies, but better still is a well-worn piece of cambric.

Seldom, apart from cases of steaming, is it necessary to clean the inner or convex surfaces of the condenser, and since this may possibly result in scratching the lenses, the task should be undertaken only when the necessity is obvious.

Nearly all condensers in use today are made of crown glass, and for this reason they have a decidedly greenish tinge, which does not, however, affect their light-transmitting property to any considerable extent. Optical flint, which is colourless and also much more refractive than crown, would no doubt be better for the purpose, but the gain in illumination would not justify the enormously increased cost. *See* Enlarging.

CONSTANTS AND CONVERSION FACTORS AND TABLES

Here, arranged in tabular form for ready reference, are constants and conversion factors which will provide sufficient data for working out various calculations

Photographic formulae are given sometimes under Imperial standards of weights and measures, sometimes under the metric system, and it is useful to have tables at hand which will enable the user to find without difficulty the equivalents of either system.

A few points should be borne in mind when preparing formulae. When working from an American formula, remember that the American pint contains only 16 fluid ounces. The American fluid ounce is, however, slightly larger than the Imperial fluid ounce, and the American pint is approximately equal to 16½ Imperial fluid ounces. On the continent of Europe liquids are, for dispensing purposes, weighed and not measured.

The troy or apothecaries' ounce of 480 grains is not used in making up photographic formulae. The official ounce contains 437·5 grains. Since the troy, apothecaries' and avoirdupois grains are equal, errors are avoided by giving the weight in grains.

TABLE OF CONSTANTS

Constant		
6·28318	× Radius	= Circumference
3·1416	× Diameter	= Circumference
·7854	× Diameter squared	= Area of Circle
·009	× Pounds (avoirdupois)	= Cwts
·000455	× ,, ,,	= Tons
·001429	× Grains	= Lbs. (avoirdupois)
7000	× Lbs. (avoirdupois)	= Grains
1·2153	× Lbs. (troy)	= Lbs. (avoirdupois)
4·541	× Gallons	= Litres
3·281	× Metres	= Feet
·002205	× Grammes	= Lbs. (avoirdupois)
·00058	× Cubic inches	= Cubic feet
·01638	× ,, ,,	= Litres
6·232	× Cubic feet	= Imperial gallons
·0648	× grains	= grammes

CONVERSION FACTORS

Col. 1 × Multiplier = Col. 2.
Col. 2 × Reciprocal = Col. 1.

Column 1	Column 2	Multiplier	Reciprocal
Inches	Mms.	25·4	·03937
Feet	Metres	·3048	3·2808
Cubic inches	Cubic cms.	16·387	·061
Cubic feet	Cubic metres	·02832	35·3148
Feet per second	Miles per hour	·68182	1·4667
Lbs. (avoirdupois)	Kilograms	·45359	2·20462
Pints	Litres	·568	1·76
Gallons	Litres	4·546	·2202
Square inches	Square cms.	6·4516	·155

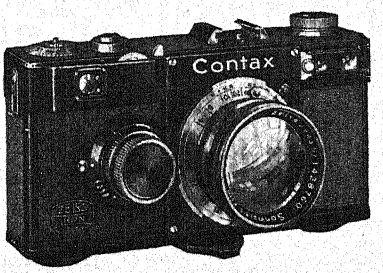
CONVERSION TABLES

Apothecaries' Weight:
20 grains = 1 scruple = 1·296 grammes
3 scruples = 1 drachm = 3·888 grammes
8 drachms = 1 oz. = 31·1035 grammes

Avoirdupois Weight:
16 drams = 1 oz. = 28·350 grammes
16 ozs. = 1 lb. = 0·4536 kilogrammes

Troy Weight:
24 grains = 1 pennyweight (dwt.) = 1·5552 grammes
20 dwt. = 1 oz. = 31·1035 grammes

Fluid Measure:
60 minims = 1 fluid drachm = 3·552 millilitres
8 fluid drachms = 1 fluid oz. = 2·84123 centilitres
20 fluid ozs. = 1 pint = 0·568 litre
8 pints = 1 gallon = 4·546 litres
(1 fluid drachm = 2 avoirdupois drams = 54·6875 grains)
1 cc. (water) = 1 gramme = 16·9 minims
1 litre = 35·196 fluid ozs.



Contax I fitted with a Zeiss Sonnar f2 lens of 2-inch focal length
Zeiss Ikon, Ltd.

CONTAX AND CONTAFLEX CAMERAS. Among the many miniature cameras taking 24 × 36 mm. pictures on standard width cine film, the Contax, made by the firm of Zeiss Ikon, Ltd., holds a high position, and since its introduction to the English market in 1932 has acquired a reputation equal to that enjoyed by any of the high-grade precision miniature cameras.

CONTINUITY IN CINE FILMS

Gordon S. Malthouse
Editor of 'Amateur Cine World,' and 'Miniature Camera World'

Whatever the theme of a film may be, it should be so presented that the action is easy flowing and devoid of incoherent abruptness. In the following article Mr. Malthouse deals with this matter of continuity in a lucid way, amplifying his analysis with examples so that the amateur may clearly understand the numerous factors relating to the subject

See *Cinematography : (3) Editing*

CONTINUITY is the easy progression of images, without any noticeable jumps or gaps in the action. It is the ideal to which all amateurs should strive, for no film can be successful without adequate continuity. In American cine circles the term is used to describe the shooting script, and this application of it is particularly apt, because continuity offers far fewer difficulties if a script has been prepared than if the film is shot "off the cuff." It is a major part of the script-writer's task to ensure smooth transition from shot to shot and from sequence to sequence. If the film is unplanned and the producer is unable to visualize it as a whole, it is not easy to link unrelated shots so that a coherent series of pictures results.

Time Lapse—Short Periods. It is explained under the heading Cinematography, Amateur : (2) Beginners (pages 320–322) and under the heading Cut, that in filming an action only sufficient of it is shot to enable the complete action to be suggested. It is, however, frequently necessary to allow for time lapse to gloss over the action omitted, even when continuous action is shown.

Example 1 : A man lights a pipe. In doing so he might perhaps go through twelve different actions : putting his hand into his pocket for matches, opening the pouch, filling the pipe, etc. There are only two salient actions : the filling of the pipe and the lighting of it. These together will suggest the complete action, but if the pipe and pouch are shown in the man's hand in one shot and in the next the pipe is already in his mouth, the transition will be too abrupt. In the second shot, therefore, we show a close-up of the man looking down out of the picture as he fills the pipe, which is not seen. Now, allowing for time lapse (much shorter than is actually the case), the shot is held for a second before he raises the pipe to his lips.

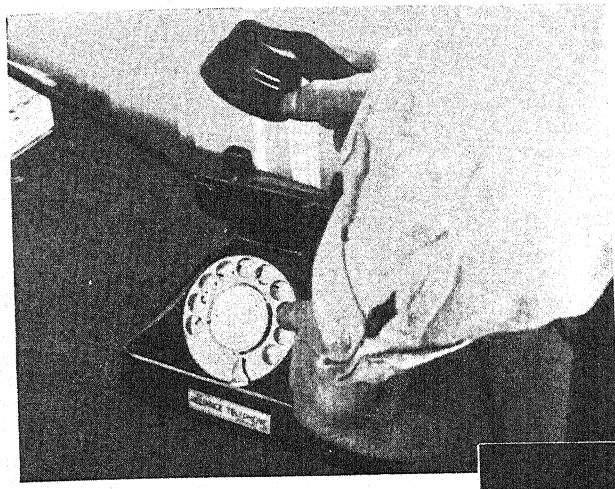
Longer Periods. In a holiday film one might take a shot of one of the family walking down a lane and an hour later film him on the cliffs looking out to sea. If the second shot is spliced on to the first the change will be too sudden. He should therefore be shown walking into the scene, and not already there. It is of no moment that in actual fact he took an hour to get there while in the film he arrives in a few seconds.

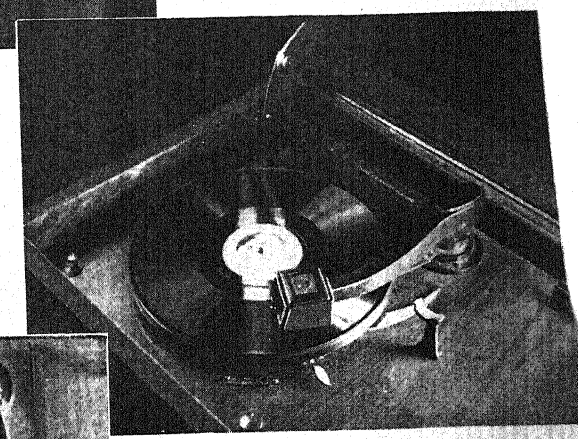
We do not, however, want to feature people in every shot, for their successive appearances would become very monotonous. The audience would know precisely what to expect and the film would, therefore, fail to hold their interest. Shots in which the leading character or characters appear must thus be joined to those in which they do not, in such a way that the development of the film proceeds unimpeded.

Example 2 : A party of hikers sets out on a ten-mile tramp which it is desired to film. The opening of the film might show them buckling on their ruck sacks and other impedimenta, and each of the next three or four shots might feature them from different viewpoints as they begin the journey. After an embracing long shot of them walking along the road, cut to a long shot of the countryside in which they do not appear. Follow with a medium shot from another angle, then a reasonably close shot of some object of interest in the field of view of the medium shot—a waterfall, say, or a quaint building. Cut to another view of the countryside, following it with one of the hikers in a different location. In this case it will be unnecessary to show the scene empty before they come into the picture, because the foregoing shots will have indicated time lapse. Note, however, that they are all related ; none of them is out of place. Some of the scenic shots could be linked together with a shot of the hikers' heavy

MATCHING SHOTS FOR CONTINUITY

By careful selection of camera angles in cine work shots can be made to link up different sequences with good continuity. The shot on the left, and the shot seen below, are from an office sequence and house-party sequence respectively. Clearly, they bear no similarity in movement or pattern

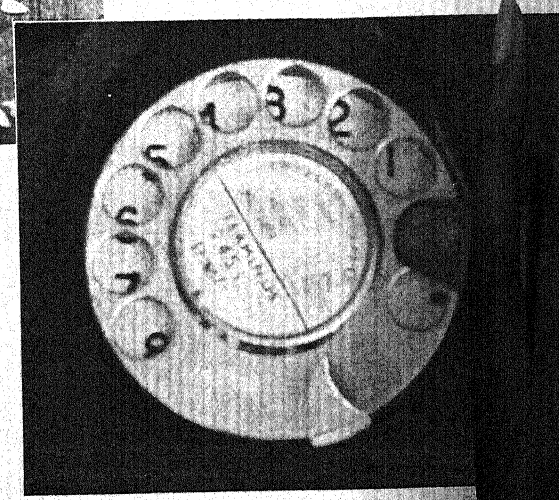


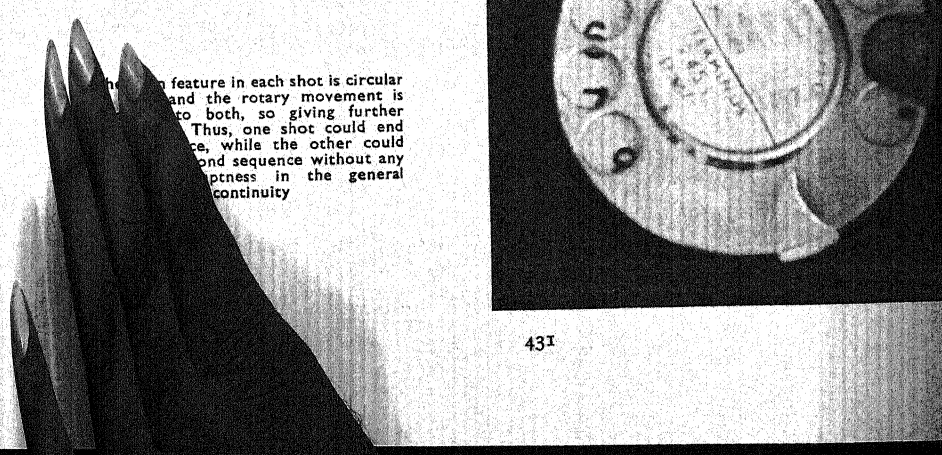


These two shots (above and right), because of the lack of resemblance, would be of little use, therefore, as continuity links unless a mechanical device such as a "fade" or "wipe" were used



Selection of another camera angle, however, to obtain a close-up, as seen on the left, secures a point of similarity that is obvious when viewed with the close-up shown below





n feature in each shot is circular and the rotary movement is to both, so giving further Thus, one shot could end e, while the other could ond sequence without any ptness in the general continuity

CONTINUITY IN CINE FILMS

Gordon S. Malthouse
Editor of 'Amateur Cine World,' and 'Miniature Camera World'

Whatever the theme of a film may be, it should be so presented that the action is easy flowing and devoid of incoherent abruptness. In the following article Mr. Malthouse deals with this matter of continuity in a lucid way, amplifying his analysis with examples so that the amateur may clearly understand the numerous factors relating to the subject

See *Cinematography*: (3) *Editing*

CONTINUITY is the easy progression of images, without any noticeable jumps or gaps in the action. It is the ideal to which all amateurs should strive, for no film can be successful without adequate continuity. In American cine circles the term is used to describe the shooting script, and this application of it is particularly apt, because continuity offers far fewer difficulties if a script has been prepared than if the film is shot "off the cuff." It is a major part of the script-writer's task to ensure smooth transition from shot to shot and from sequence to sequence. If the film is unplanned and the producer is unable to visualize it as a whole, it is not easy to link unrelated shots so that a coherent series of pictures results.

Time Lapse—Short Periods. It is explained under the heading Cinematography, Amateur: (2) Beginners (pages 320–322) and under the heading Cut, that in filming an action only sufficient of it is shot to enable the complete action to be suggested. It is, however, frequently necessary to allow for time lapse to gloss over the action omitted, even when continuous action is shown.

Example 1: A man lights a pipe. In doing so he might perhaps go through twelve different actions: putting his hand into his pocket for matches, opening the pouch, filling the pipe, etc. There are only two salient actions: the filling of the pipe and the lighting of it. These together will suggest the complete action, but if the pipe and pouch are shown in the man's hand in one shot and in the next the pipe is already in his mouth, the transition will be too abrupt. In the second shot, therefore, we show a close-up of the man looking down out of the picture as he fills the pipe, which is not seen. Now, allowing for time lapse (much shorter than is actually the case), the shot is held for a second before he raises the pipe to his lips.

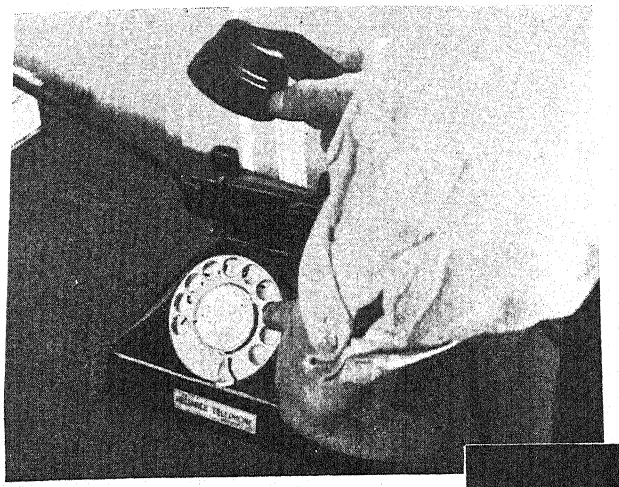
Longer Periods. In a holiday film one might take a shot of one of the family walking down a lane and an hour later film him on the cliffs looking out to sea. If the second shot is spliced on to the first the change will be too sudden. He should therefore be shown walking into the scene, and not already there. It is of no moment that in actual fact he took an hour to get there while in the film he arrives in a few seconds.

We do not, however, want to feature people in every shot, for their successive appearances would become very monotonous. The audience would know precisely what to expect and the film would, therefore, fail to hold their interest. Shots in which the leading character or characters appear must thus be joined to those in which they do not, in such a way that the development of the film proceeds unimpeded.

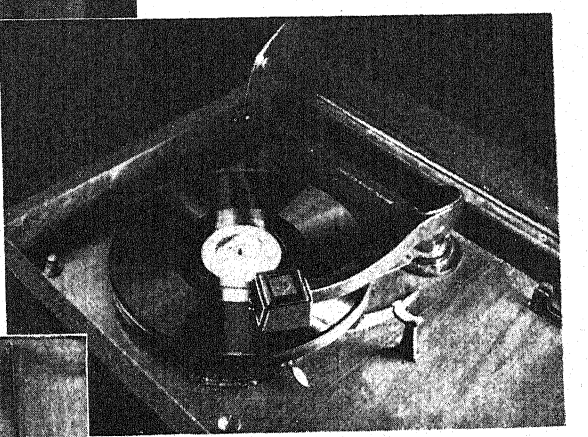
Example 2: A party of hikers sets out on a ten-mile tramp which it is desired to film. The opening of the film might show them buckling on their ruck sacks and other impedimenta, and each of the next three or four shots might feature them from different viewpoints as they begin the journey. After an embracing long shot of them walking along the road, cut to a long shot of the countryside in which they do not appear. Follow with a medium shot from another angle, then a reasonably close shot of some object of interest in the field of view of the medium shot—a waterfall, say, or a quaint building. Cut to another view of the countryside, following it with one of the hikers in a different location. In this case it will be unnecessary to show the scene empty before they come into the picture, because the foregoing shots will have indicated time lapse. Note, however, that they are all related; none of them is out of place. Some of the scenic shots could be linked together with a shot of the hikers' heavy

MATCHING SHOTS FOR CONTINUITY

By careful selection of camera angles in cine work shots can be made to link up different sequences with good continuity. The shot on the left, and the shot seen below, are from an office sequence and house-party sequence respectively. Clearly, they bear no similarity in movement or pattern

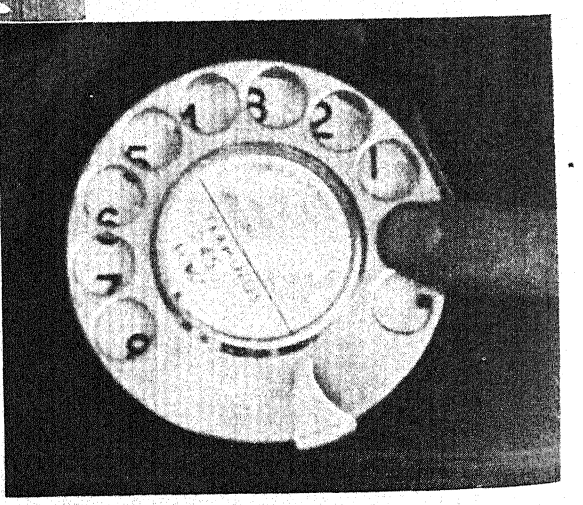


These two shots (above and right), because of the lack of resemblance, would be of little use, therefore, as continuity links unless a mechanical device such as a "fade" or "wipe" were used





Selection of another camera angle, however, to obtain a close-up, as seen on the left, secures a point of similarity that is obvious when viewed with the close-up shown below



The main feature in each shot is circular in form and the rotary movement is common to both, so giving further similarity. Thus, one shot could end one sequence, while the other could open the second sequence without any obvious abruptness in the general continuity

boots clumping along, or a shot of a pleasant view could be introduced by a close-up of a map held by one of the party.

It will be appreciated that this little episode is a continuous one. Events that are widely separated in time and space cannot always be conveniently linked by such means. For notes on continuity in such cases *see* Continuity Devices (below) and the heading Editing.

The film-maker may not want to show people at all, but to concentrate entirely on producing a scenic picture. In this case he can, in many instances, link the various sequences by matching the last shot of one sequence with the first of the next; *e.g.* a long shot of the countryside—medium shot of another aspect of it—various views of significant features—medium shot of a little waterfall seen in one or more of the previous views—cut to one or two shots of it from different angles and end sequence with a fairly big close-up of the water tumbling down. Match this last shot with one of water pouring out of a tap; trolley back (or, if this is not possible, take a medium shot) revealing a trough in a farmyard, a pail of water being drawn off by a labourer. Follow the labourer as he takes the pail to an outhouse and swills down the floor. Cut to various shots of the farmyard and its denizens. Enlarge the field of view until they embrace the surrounding countryside, the farmyard still being in the picture, but no longer featured so strongly. Pick out some object of interest in these long shots and then go off to explore it. And so on.

Continuity Devices. Mix. A scene appears on the screen before the preceding one has left it; *e.g.* in Example 1 above, mix from a medium shot of the man filling his pipe to a close shot of him smoking it. The mix speeds up the transition, but often at the expense of realism, for it makes the audience conscious of the fact that it is only a picture they are seeing. The objection of unreality applies with greater force to the Wipe, in which a scene appears to peel off the screen, revealing another underneath. The wipe is too frequently evidence that the movie-maker could not think of any better way of linking his shots, and it often denotes, too, that they lack inherent continuity. It is used to the best effect when it follows the pattern of the movement; *e.g.* as a page of a guide book is turned over it is wiped off the screen, the wipe taking the same direction as the movement of the page, revealing one of the actual scenes described in the book. The effect of a wipe can also be produced by a straight cut, *e.g.* a person walks away from the camera, the first few frames in which he fills the camera view being completely dark; things shown in close-up can be lifted up or brought down into the camera field so that they obscure it entirely.

Fade In and Out. The scene gets darker until the screen is quite black. The screen then gets brighter, revealing another scene which comes to full brilliance. The fade, by its nature, is most frequently employed to indicate a considerable lapse of time and should not be used to link two scenes, in which there is no occasion to emphasize time lapse.

Iris In and Out. This device is somewhat discredited today and is not often used. The scene is blotted out by a steadily decreasing circle, the area outside the circle being dark. Conversely, the scene is introduced by an expanding circle. A scenic film could be closed by an iris out on the setting sun over the sea, a family film by an iris out of baby clambering upstairs to bed.

The iris is best used to begin and end films and not to link the sequences, although there are occasions when it is useful to concentrate attention in this manner on some particular aspect of a scene; *e.g.* in a sequence showing the manufacture of chocolate, a shot of the chocolates in their box is irised out.

The iris in can be effectively used in a comedy to mislead the audience; *e.g.* iris in to a woman weeping copiously. As the field of view widens it is seen that she is peeling onions. The same effect can, however, be obtained by a trolley back.

For methods of producing mixes, dissolves, fades, etc., *see* entries under their respective headings.

Matching Shots. In the suggestion above, for a scenic film, a shot of a waterfall is matched with one of water pouring from a tap. Continuity can also be achieved by matching identical shots taken in different circumstances; *e.g.* in Example 2 close shots of the hikers' boots are used to link the scenic shots. In this case the action is more or less continuous, but if it is desired to

indicate time lapse, cut from shot of clean boots sprightly marching along to a shot of the same boots, very much travel-stained, their wearer now shuffling along in a weary manner. A smoother transition is obtained by dissolving from one shot to the next, the dissolve being a combination of the mix and fade.

A host of similar examples will suggest themselves: a heaped-up plate dissolving to the same one empty, a tree with bare branches dissolving to a tree in its summer mantle of foliage. The matching shot can also be used not as a continuity link but as a commentary—usually a rather cynical one; *e.g.* match a shot of Uncle Harry bathing with one of a walrus taken at the Zoo.

Stock Shots. Precisely because they are stock shots, and therefore hackneyed, the following should be used with discretion: The hands of a clock revolving, leaves flying off a calendar (both produced by stop motion), sand running out of an hour-glass (or, in an interior family film, an egg-timer), close-up of the steam whistle of a liner to indicate departure on a voyage. The clock, calendar and hour-glass shots are direct representations of the passage of time and therefore focus the attention of the audience on it, whereas in most cases it will be found advisable not to draw undue attention to it, *i.e.* in a family film there would be little point in showing by means of the revolving hands of a clock that lunch begins at one o'clock and dinner follows at 7.30, for this information is of no particular interest. If, however, father promised to be home at 6.45 and did not arrive till 11, then the shot would be in place.

Indirect Shots. Continuity can often be smoothed over by showing a person's reaction to an incident when it is impracticable to show that incident objectively, *e.g.* the movie-maker wants to show a car crash. It would be impossible for him to show an actual smash, and yet there will be an awkward gap in continuity if it is not suggested. It could, however, be suggested in the following manner: L.S., two cars approaching each other. M.S. from the road. M.S. from the side of the road. C.U. Car wheel furiously revolving. M.C.U. Driver's face registering horror as he pulls at the brake. M.S. Showing cars much nearer each other than in previous M.S., pedestrian on the pavement well in evidence. Cut to C.U. of pedestrian looking out of the picture. Suddenly he winces and closes his eyes. Cut to M.S. of wheel, ostensibly wrenched off from one of the cars (the spare wheel will do) slithering across the road into the gutter.

Throwing Out of Focus. Shots can be thrown out of focus to preserve continuity, *e.g.* in an industrial film we have a shot of a line of boxes on a conveyor belt approaching the camera and for reasons of continuity need to show them receding, but omitted to take this second shot. We have an opportunity later of taking a shot of similar, but not precisely the same, boxes. If we pan on a close-up of the first shot, finishing up out of focus and then begin another pan, also out of focus, on the other boxes, but bringing it afterwards into focus, the cut will be practically imperceptible and the audience will accept the two strings of boxes as one and the same.

Sub-Titles. These are a useful continuity link but should be avoided if continuity can be suggested pictorially. Do not use such sub-titles as "Meanwhile," and "Later." The lapse of time should be conveyed in pictures or by a mechanical device such as a fade. Sub-titles giving the name of a place are rendered unnecessary by shots of sign-posts, A.A. signs, railway station signs, etc. If two sequences are linked by a sub-title, it should preferably refer to them both, *e.g.* it is desired to link some shots of farmyard scenes in Sussex with shots of London street scenes. The sub-title could run: "Having made enough silk purses out of these sows' ears we can afford a trip to London." It would be faulty continuity to follow the farm shots with a sub-title such as "The hub of the Empire," because it has no discernible link with a Sussex farmstead. In this example the sub-title is a poor second best—it would have been preferable to have had sufficient linking shots to convey the continuity pictorially.

Each of the continuity devices described above should be employed with discretion, and care should be taken not to repeat the same device indiscriminately. The audience should not be consciously aware of them; the links should be unobtrusive. The best way of ensuring this is to plan the film in advance.

CONTRAST IN NEGATIVES AND PRINTS

David Charles, F.R.P.S.

This difficult and at times controversial subject is here presented by a practised hand from the point of view of the experienced photographer. Its consideration in terms of scientific theory will be found under the headings : Negatives, Density and Tonal Values ; Prints, Density and Tonal Values

See also Gradation

CONTRAST is the difference in density between various parts of a photograph which produces the effect of visual brightness. The subject has several distinct angles which should be considered separately, but because usually they are regarded as one, there is considerable vagueness and confusion when the subject of contrast is spoken of or written about.

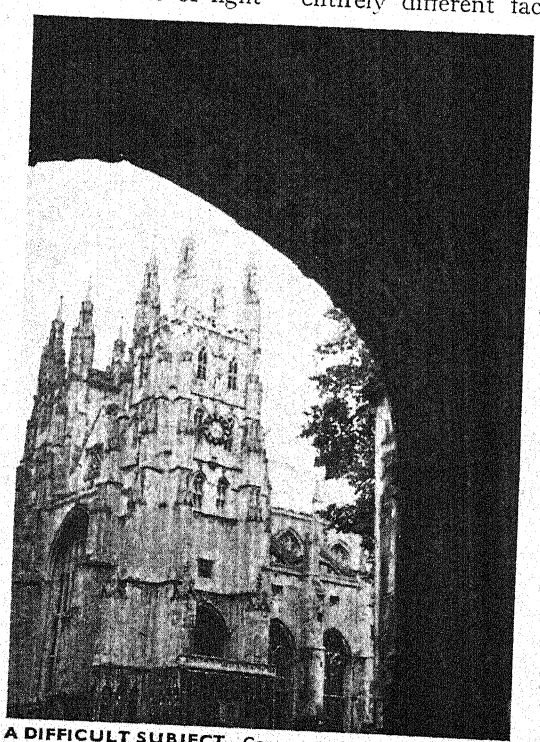
A " correctly exposed " negative may be developed to such a stage of contrast as between the densest high-light detail and the thinnest " shadow " detail that on a particular grade of paper the print will reproduce the latter as " maximum black " and the former as white paper. It is often assumed that then the print will automatically have correctly reproduced the contrasts of light-and-shade seen in the original subject. That is the " theoretical " angle.

It is also frequently assumed that two or more emulsions of different speed or variety may be each exposed on the same subject with varying times to compensate for the differences in sensitivity, and that if they are then developed to a similar contrast, then prints from such negatives will be approximately identical. That is the " emulsion " angle.

A third assumption is that if several identically exposed negatives are developed to differing strengths of contrast, and are then printed on papers of compensating contrast, prints of almost identical character can be obtained. That is the " printing-paper " angle.

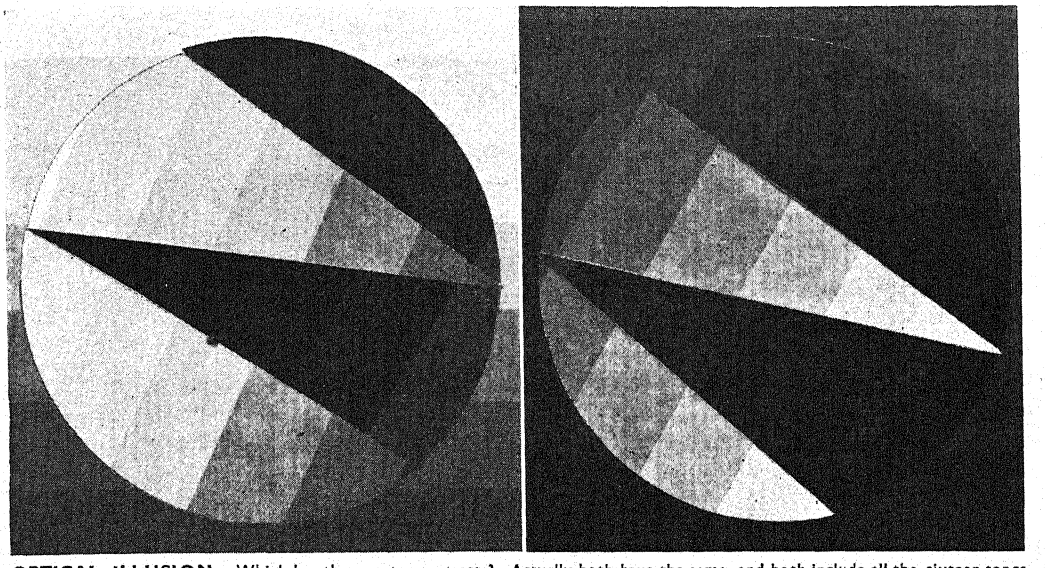
A tremendous amount of research is carried on and recorded in manufacturing laboratories to the end of providing emulsions which shall carry out these assumptions in actual practice, and of publishing processing methods which shall retain the virtues of those emulsions. Consequently there is a certain amount of truth in all these assumptions, but the circumstances in which any one of them is even reasonably true are still limited in the extreme.

This fact is due to no fewer than four entirely different factors. The first factor is that of the subject. The kind of subject on which laboratory theory may be correctly translated into practice is what is described as " open landscape." Immediately a subject of such limited " scale of tones " is made to include some extra brilliant high-lights, or some extra-dark detail, or both, no emulsion yet in existence can correctly translate into corresponding densities all the very extensive range of contrasting tones which can be seen by the observant eye in practically every subject. This fact is almost

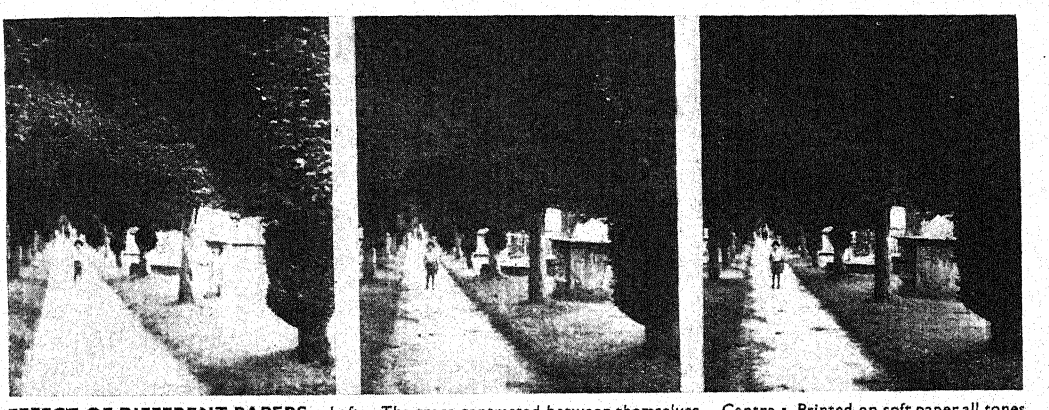


A DIFFICULT SUBJECT. Contrast is poor in both arch and cathedral, and to increase it in either would weaken the other

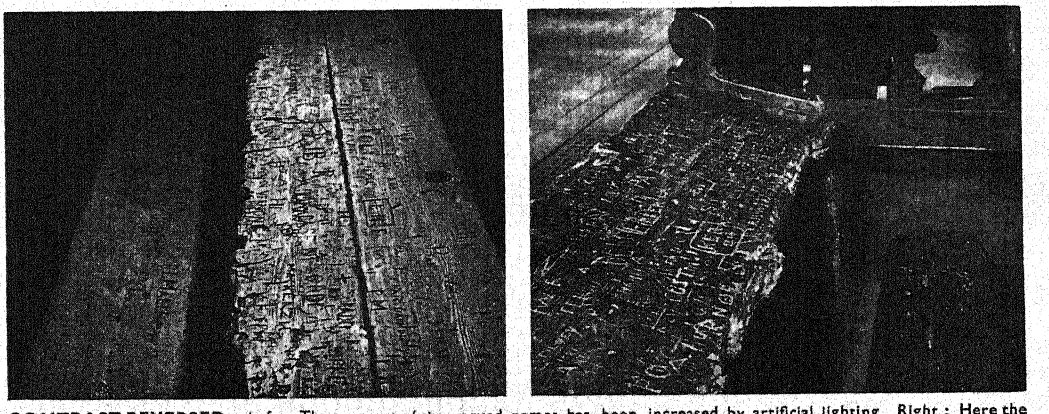
Photo, Joan Charles



OPTICAL ILLUSION. Which has the greater contrast ? Actually both have the same, and both include all the sixteen tones of a normal bromide paper. In this case the eye is deceived by the distribution of the contrasts



EFFECT OF DIFFERENT PAPERS. Left : The trees contrasted between themselves. Centre : Printed on soft paper all tones are reproduced, but falsely. Right : Where the contrasts are too great for correct translation, a normal paper produces an acceptable compromise



CONTRAST REVERSED. Left : The contrast of the carved names has been increased by artificial lighting. Right : Here the contrast has been reversed and slightly increased by a change in the direction of the lighting

Photos, David Charles, F.R.P.S.

commonplace, but the chief implication of this fact is that the most attractive subjects nearly always do include such handicaps to the theoretical perfection sought !

The second factor is that various kinds of emulsion respond with marked differences of tone-rendition to these departures from the theoretical ideal subject.

Limitations of Printing Paper

The third factor is the limited power of printing papers to reproduce the differences in density and contrast which may exist in a negative. Bromide papers of average grade are capable of producing only about sixteen recognizably contrasting shades of grey, including the faintest possible tone and the deepest possible black. Most subjects contain many more distinct tones than that, so, in a bromide print, some of the tones must be either false or absent.

The falsity, or absence, of contrast between many of the tones in most photographs is due to the combined influence of the factors just described. That the facts often are not recognized is due partly to the fact that they are indiscriminately distributed in small patches, and that the human eye is entirely unable to recognize the precise degree of contrast, or the number or accuracy of tone-values in any ordinary negative or print. And in the whole of this country there are but a handful of people in possession of the highly scientific instruments with which negative densities can be measured. Consequently the increasing tendency to describe negative contrast in mathematical terms of such measured densities appears rather ridiculous. It is, in fact, a possibly harmless but also useless form of snobbery.

This lack of perception in the human eye is the fourth and not the least important factor. In fact, nearly every photograph is in part an optical illusion and the human eye often prefers the illusion to the reality. In a photograph of a wood the eye does not particularly desire to distinguish every individual leaf on every individual tree.

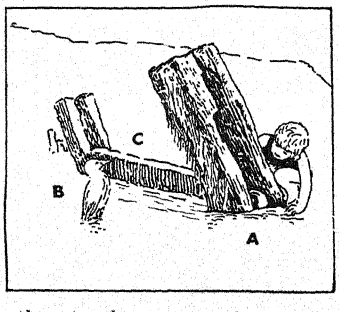
In actual practice, and leaving outside the argument such devices as local treatment of negatives or prints, it is an indisputable fact that the truest reproduction of the contrasts in most subjects is obtained by " correct " exposure on a double-coated emulsion, developed to suit a " normal " grade of printing paper. That some contrasts are falsified, and others lost does not alter the fact that theoretically " normal " results are those which are truest to the subject, and preferred by most people.

Effects With Slow Emulsions

When any departure whatever is made from correct procedure, in the way of increasing normal contrast, it is inevitable that still more tones of gradation will be falsified, and still more of them disappear either into pure white or pure blackness, or both. This applies as much to use of slower types of emulsion, or to increase of contrast in development of the negative as to the use of " contrasty " grades of printing paper. When a departure is made from normal towards softness of contrast such as by making weaker negatives, or by using " soft " paper,

(*Continued in page* 441)

Notes on the Composition of " HELLO ! "



This is a finely balanced composition, and the reasons for its harmony are easy to read. There are two main elements—the posts and the boy forming the group A, and the smaller posts and the bird combined in the group B. These are brought just far enough into the picture-space, and do not compete with each other so as to divide the interest.

The group A is larger and more important than the group B, but the latter is by no means insignificant in its repetition and balancing. The two are linked together in three ways—by the beam C, by the broad band of the distant cliff, and by the mutual curiosity of the boy and the bird. There is an incident or " story " in the picture, simply but forcibly presented

All the tones, surfaces and textures are realistically rendered, with luminosity throughout, and a suggestion of open air and freshness. Probably the reason for the bird's immobility (oil-clogged plumage) is evident to the initiated but there is nothing distressing about it, as the bird is alert and beautiful, and will most likely have reason to be grateful for encountering such a friendly human as the charming boy.

The photographer is to be congratulated on the excellent use he has made of his opportunity. The rendering, both technically and pictorially, could hardly be bettered in any respect.

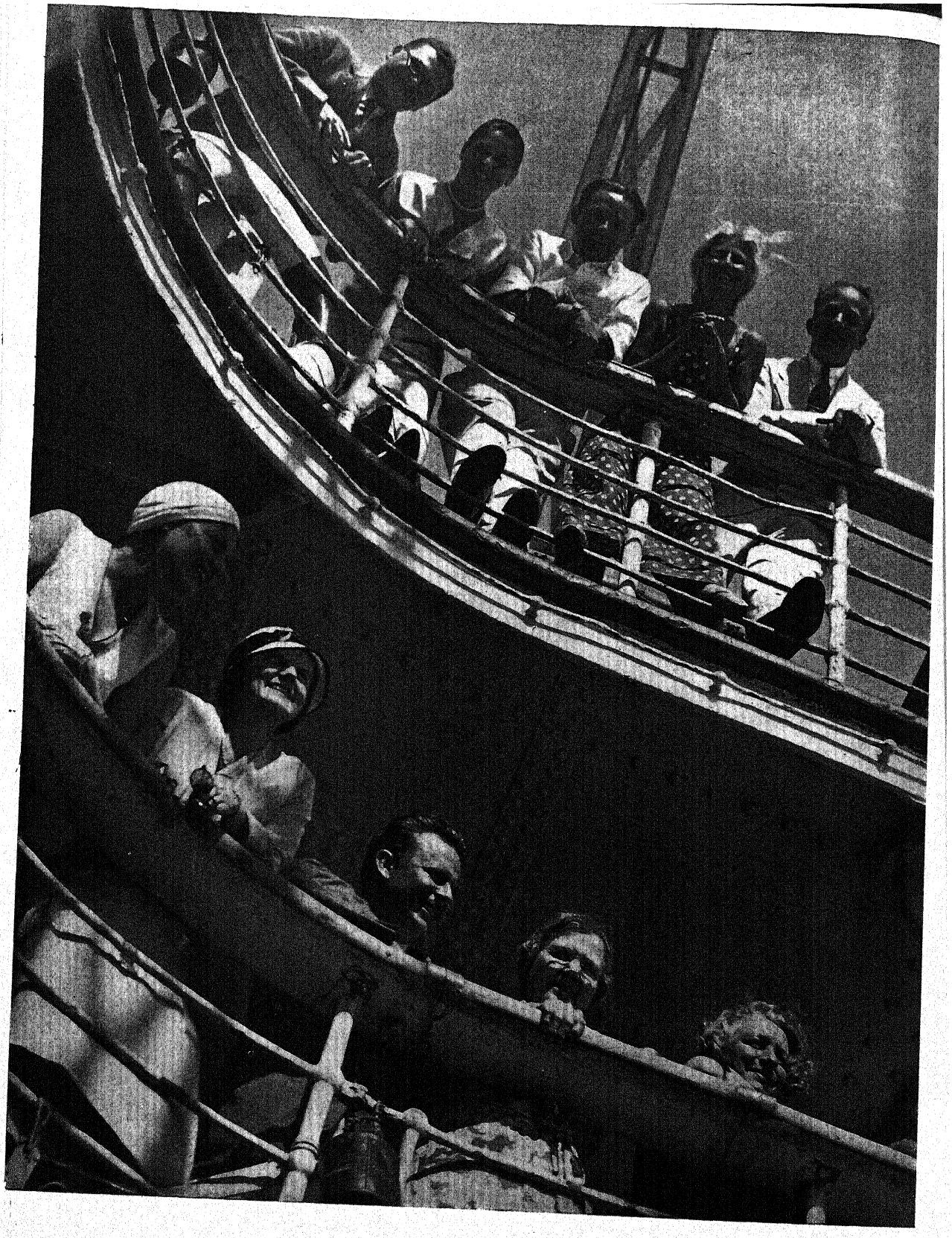
W. L. F. W.



W. K. Chadburn

'HELLO!'

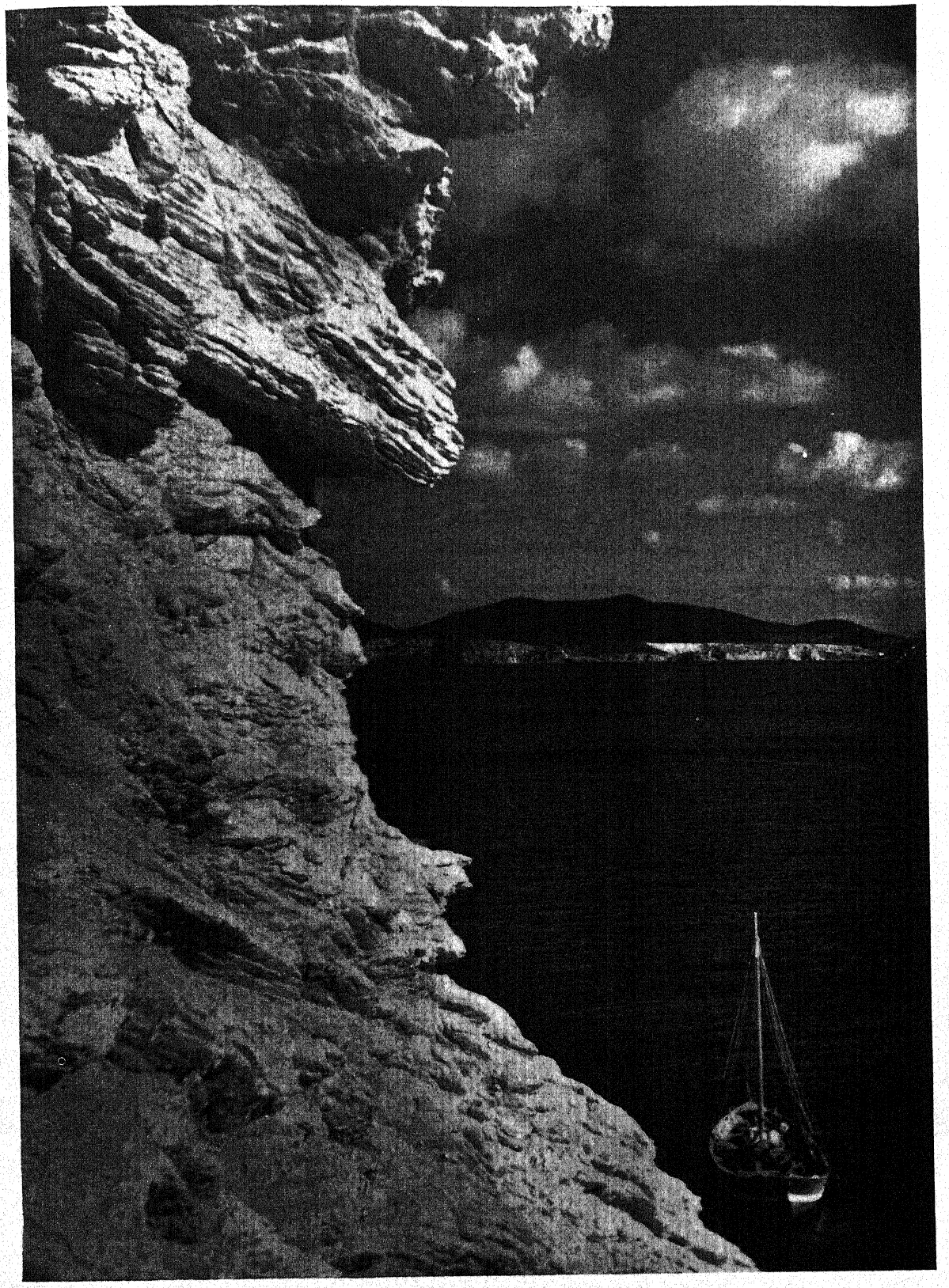
Prizewinning photograph in the Isle of Man Publicity Board's Photographic Competition, 1936. Taken July afternoon, at Kirk Michael; Rolleiflex camera, Zeiss Pernox pan. film; 1/100 sec. at f5.6, light yellow filter (see article on Competitions, pages 415–419)



HOLIDAY

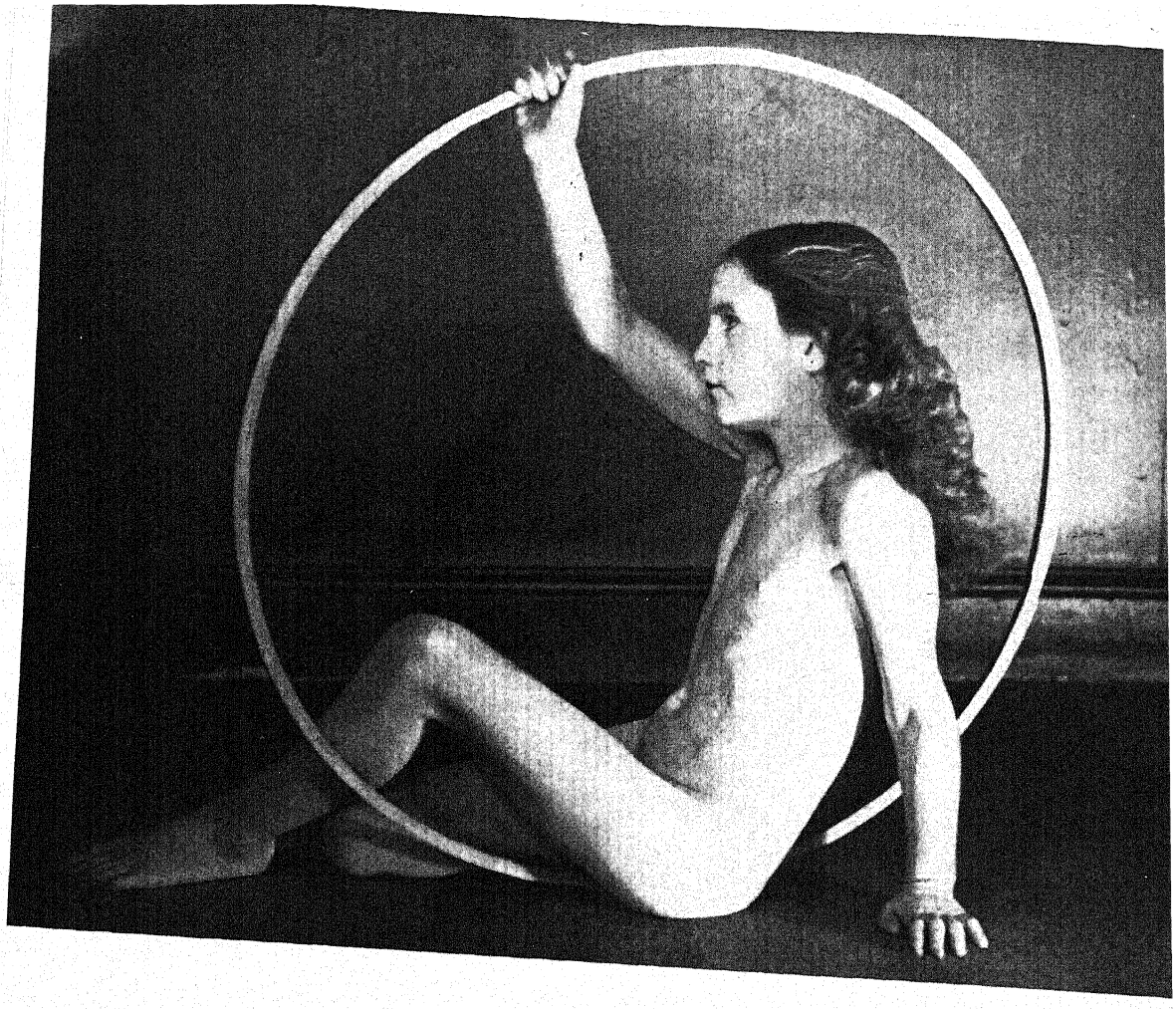
Robert Bagby

From the London Salon of Photography *(see article on Cruising, pages 458-462)*



THE ROCKY COAST OF IBIZA Baron Mario Bucovich

(See article on Contrast, pages 434–441)



NUDE

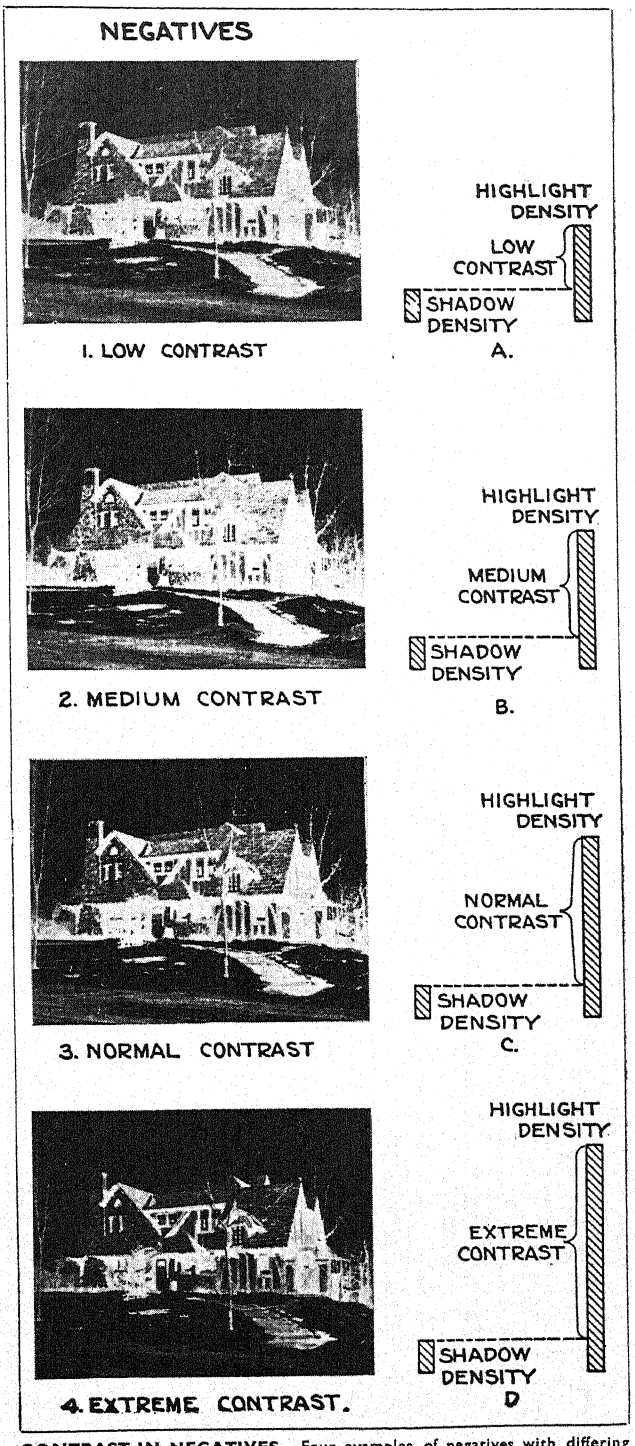
Prizewinning photograph in "Modern Encyclopedia of Photography" Competition; Super Ikonta 3.5 Tessar lens; Agfa FF film; 1/10 sec. at f3.5; two photoflood lamps

C. Wyman

it is often the case that more actual tones may be recorded, but they may be of such subtle character as compared with what was seen in the subject that they prove disappointing. When apparently compensating combinations of these two departures occur, as, for instance, the use of " soft " paper for over-contrasty negatives, or vice versa, results are scarcely ever so true, and are far more difficult to standardize in quality.

The proper place, in fact, for introducing contrast and brightness of the resulting print is upon the subject when it is being photographed. That is achieved by selection in the case of outdoor subjects, and in the case of indoor subjects by judicious arrangement of the subject, its surroundings and the light. When the lighting itself is controllable, it is that control which should decide the degree of contrast in the final print. In this connexion it should be noted that the print will always lose many of the visible tones of the subject, especially in the highest highlights and the deeper shadows, and therefore the effect as seen should be much softer than the final effect desired.

To sum up by a simple example, if a portrait is made with one side of the face towards a window, the other side being poorly lit, no softness of the negative or of the printing paper will ever compensate for the abruptness of the contrast between the two sides. If, on the other hand, the same face be flatly lit against a pale grey background, extra density of the negative, or use of " contrasty " paper, will exaggerate the contrast between the actual tone-values in the original, but even these means cannot introduce the illusion of brilliance in the final print.



CONTRAST IN NEGATIVES. Four examples of negatives with differing contrast. These negatives have low, medium, normal and extreme contrast, and for prints a different grade of paper would be required for each. The low contrast negative would necessitate a contrasty paper, while with the second, third and fourth negatives paper of normal, medium soft, and soft grade. The diagrams show the proportions of highlight density in relation to uniform shadow density, producing increased contrast where highlight density is greatest

COPYING WITH LARGE AND MINIATURE CAMERAS

W. R. Ayling, A.I.P.A., A.R.P.S.

The making of copies of pictures and photographs is intricate work that requires skilful handling and careful selection of material. In the following article the author explains how copying can be best carried out with different types of camera. He also gives advice on choice of materials, equipment and the use of lighting for specific subjects

See also Recording and Copying Apparatus

UNDER this heading is included also photography of flat objects where it is desired to show the texture, pattern or colour.

Almost any camera can be used for copying provided that it has sufficient extension of bellows, or what passes for bellows in the standard miniature camera. In addition, the lens should have good covering power and show no falling off at the edges. Naturally the lens should also be free from features which would cause distortion in the resultant picture. For work of this description I use a Sinclair Una (*see* illustration in page 446) with triple extension, fitted with a Ross lens; in addition, I utilize the full Leica Universal Reproduction Device for particularly intricate work such as reproducing the texture of silk. A good quality focussing magnifier is also an asset. In practice, I have not found any appreciable difference in the quality of reproduction between using the large camera mentioned above and the more elaborate miniature device when carrying out straightforward copying; but in cases of special work, where the operator desires to work to close limits of size, the miniature scores heavily.

Simple Apparatus. There are few special devices for copying manufactured for ordinary cameras, consequently the user is compelled to exercise his imagination and ability to devise stands both for his camera and for the object to be copied. Failing better apparatus, a good solid table whereon the camera can be clamped, with an easel of some description which can be also firmly clamped, will serve. It must, however, be clearly understood that vibration as between camera and object must not be permitted, The manufacturers of miniature cameras have designed and sold special pieces of apparatus for conveniently copying objects. These devices vary in size and cost, some being portable for library or museum use, others being intended for more permanent quarters.

The smaller portable apparatus usually takes the form of a light framework which is placed over the object to be copied. Upon an arm, projecting from the top part of the framework, the camera is suspended. The whole is most rigid and the planes of the lens, the film or plate surface, and also the object to be copied are automatically placed in the necessary position. Focussing in cases such as these is by marks on the supporting stem of the camera, and small supplementary lenses alter the focal length of the lens, which permit close pictures of small objects.

Alternatively, the tubes mentioned elsewhere in this section are utilized to allow for very close work. In this case focussing is by measurement—film surface to lens and lens to object surface. In some cases visual focussing is possible, where a rotating platform permits the object to be viewed through a powerful magnifier and a small ground glass screen. When it is desired actually to take the picture, the platform revolves in an eccentric manner, bringing the body of the camera into position over the lens in place of the viewing screen. The exposure is then made, and the platform revolved for the next picture to be focussed. The type of focussing used in this case is known as aerial focussing.

Two photoflood lamps, or similar type of lighting equipment, should also be in the possession of the user, for there are a surprising number of copying jobs where even illumination is not possible with daylight.

Negative Material. When deciding on the most suitable material to use for copying, consider the type of picture or photograph: whether is is coloured, stained or discoloured with misuse or age; and generally treat the work as if it were a landscape. If the picture to be copied is in black and white or similative, colour blind negative material can be used to advantage. For copying fine line work, where there are no half-tones or gradations of grey, positive film or colour blind process plates or film should be used to

get the best results. For oil paintings in full colour or pictures of this nature, a panchromatic film or plate should be used, with the appropriate filter to obtain a correct rendering of colours and half-tones. Some panchromatic films are more sensitive to reds than others, whilst certain brands are very sensitive to other colours of the spectrum. Refer to the following table :

Colour-Blind Films	Partly Corrected for Colour	Fully Corrected for Colour
Kodak Positive film. Process plates (ordinary). Ilford Ordinary plates. *Or any film or plate known to be insensitive to colours.*	Agfa Isochrome F film. Ilford Special Rapid plates. Ilford Fine-Grain Ordinary cut film. Kodak Ordinary film. Kodak Verichrome film. *Or any slow speed fine-grain, ortho. plate or film.*	Agfa Isopan FF film. Kodak Panatomic film. Ilford Panchromatic cut film. Ilford Special Rapid Pan. plates. *Or any slow speed colour-corrected fine-grain plate or film.*

Development. This should follow the usual lines ; for fine line work use a very contrasty developer, or for soft gradations of grey use a developer of known soft contrast. The following are recommended :

For Maximum Contrast

SOLUTION A

Sodium bisulphite	25 gms.
Hydroquinone	25 gms.
Potassium bromide	25 gms.
Water to make	1,000 ccs.

SOLUTION B

Caustic soda	45 gms.
Water to make	1,000 ccs.

Take equal parts of A and B, no further dilution required.

For Normal or Soft Gradation Negatives

Johnsons Fine-Grain Developer.
Johnsons Fine-Grain Meritol Developer.
Kodak D76.
Tetenal Leicanol (particularly suited for miniature negatives).

For more ordinary results refer to the formulae given under Developers and Development.

Filters. In copying straight black-and-white pictures which are in a good state of preservation, no filter is necessary. It is when an old or stained photograph is to be reproduced, or when copying an engineer's blue-print, or a material in colour, that filters are necessary.

For blue-prints, a red filter (the ordinary tricolour red will serve) should be used with panchromatic film. The extra exposure recommended by the maker of the film should be noted. For old, faded or stained photographs a similar procedure will often yield a satisfactory result. For oil paintings, pieces of textile and other material in colour, and similar flat objects, a fully corrected panchromatic film should be used without a filter. If there should be a preponderance of one colour in the original which it is desired to even down, a filter can be used, the particular filter depending on the colour in the original which is to be toned down (*see* Filters).

When using a large camera such as described above for the purpose of copying, the apparatus must always be rigidly mounted on a tripod of substantial weight, or other steps must be taken to prevent camera-shake. The extension possible with the particular make of apparatus will decide what focal length of lens can be used and what will be the distance from lens to object. In the case of miniature cameras, however, it is necessary to remove the lens and insert a tube or series of tubes between lens and camera body, in order to be able to get the object image large enough on the negative.

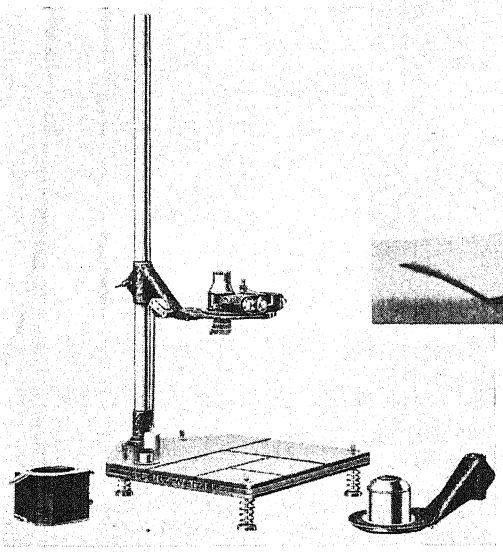
The Leica Universal Reproduction Device gives all the benefits of the larger and more cumbersome apparatus, without its weight. Lighter still and more portable forms of equipment are available from most of the makers of miniatures.

Another valuable piece of apparatus is a Universal stand for copying and reproduction work for the Contax camera. This special copying device consists of a U-shaped base with three adjustable legs and a metal upright, upon which is clamped a sliding device which holds the camera extension tubes for the purpose of focussing near objects and, for special circumstances, a reflex device which takes the place of the camera for the purpose of securing the focus, which device is afterwards removed and the camera body substituted.

In common with other devices of this kind, this piece of apparatus has special illumination attachments. The Contax Universal stand, for copying and reproduction, and the Leitz Universal reproduction device are the only pieces of apparatus which permit of

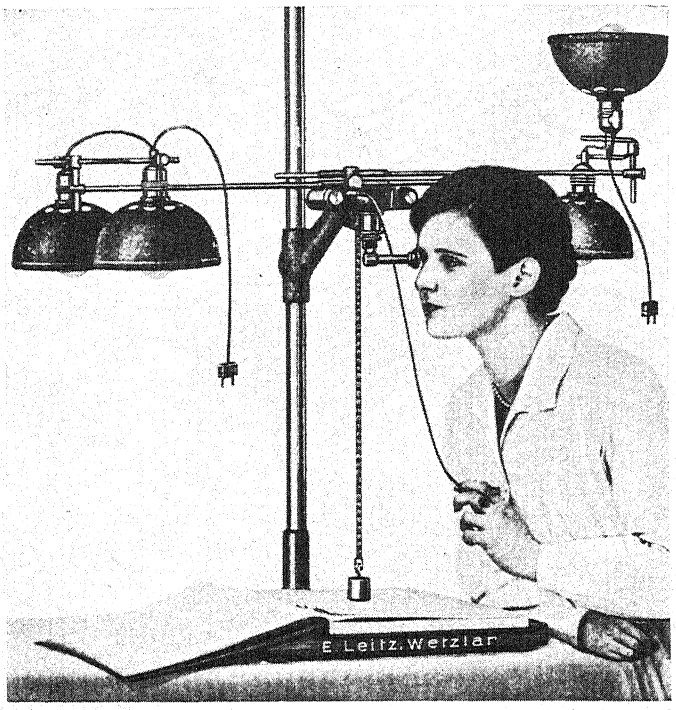
direct photography of small objects such as insects and textures of material with a magnification of from 2 : 1 to 25 : 1.

Lighting the Object. It is imperative that whatever the lighting it should be evenly distributed over the full extent of the surface of the object to be copied. There is one exception to this rule, however, and that is



where a texture which is raised is to be reproduced. In such a case, first secure the even illumination of the surface, and then add an extra light to one side, bringing into slight relief such irregularities of the surface as will distinguish the texture from a merely flat object. As an alternative to adding an extra light, one of the existing lamps, if lamps are being used, can be moved a little nearer to the object. The photograph of the wall in page 446 shows this relief where that of the tile does not. This effect was secured by moving one of the lamps to about two-thirds of the distance from the object, as compared with the position of the other lamp.

Position of Camera and Object. It is most important that the plane in which the object stands should be exactly parallel to that in which the lens panel and the plate or film are situated. In the case of the larger



COPYING APPARATUS. Above, Leica reproduction stand equipped with sliding arm, illuminator and Leica camera with angle view-finder Left, part of Leica copying device with Leica in position on rotating table and bellows extension detached

type of camera great care must be exercised, otherwise distortion in the result will be certain. The illustration in page 446 shows the rising front and the tilting front and back of the Una camera, which ensure the parallel planes referred to.

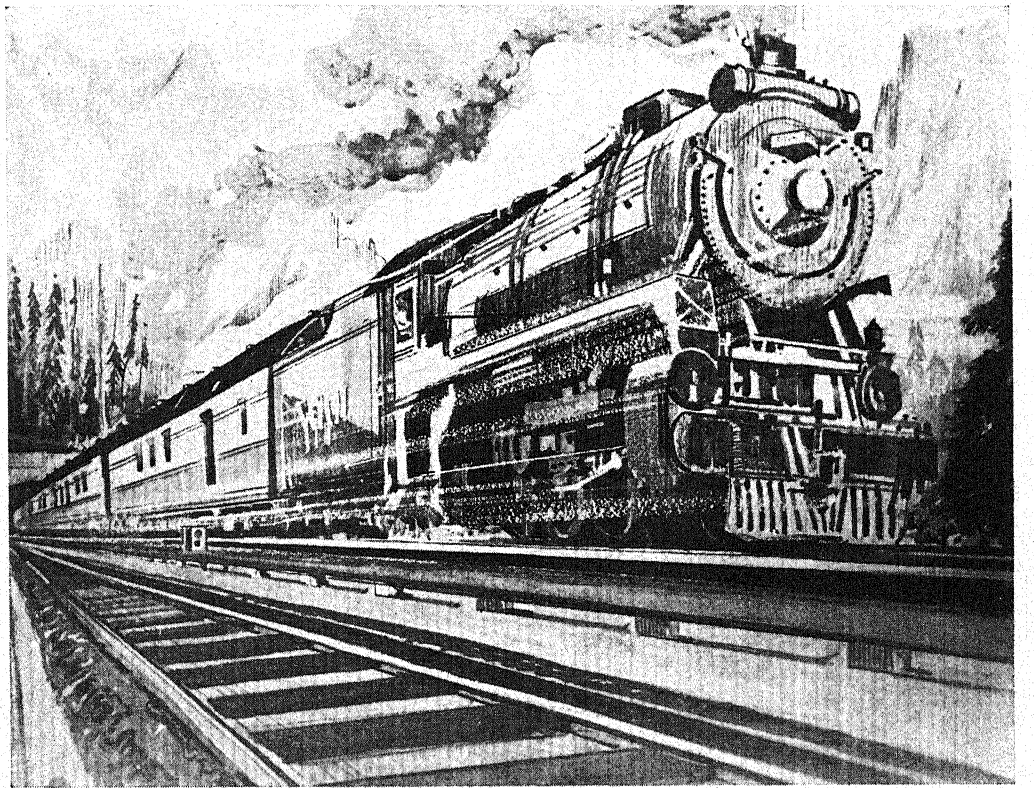
It is often desired to copy a painting which is in a position where it cannot easily be moved. Suppose a picture were hanging in an art gallery and it was desired to copy it without moving the picture from the hanging position. Here is a case where the rising and tilting front would be employed to ensure that the plane of the object and the plane of the lens mount and of the negative material were parallel.

In the case of the copying or reproducing devices for miniature cameras, the matter is taken care of by the device itself, and it is almost impossible to err where the picture or object can be placed in the copying device. In cases of pictures, hanging or fixed, the same care must be taken as detailed for the larger apparatus. Depth of focus does not enter into the matter of copying flat objects. Focus must be dead correct.

Stopping Down. Normally there should be no need to stop down the lens of a good miniature camera for copying purposes. As normal conditions are seldom encountered, however, it is advisable to stop down to the aperture recommended by the manufacturers of the particular lens. Most lens makers state something to this effect: ". . . this lens reaches its greatest resolving power at *f*4.5 or other stop) . . . " and it is naturally advisable to follow their instructions. In the case of the larger type of camera it is advisable to stop down considerably. A lens working at an open aperture of *f*4.5 should be closed to *f*9 or *f*11. This is from considerations of sharpness of detail.

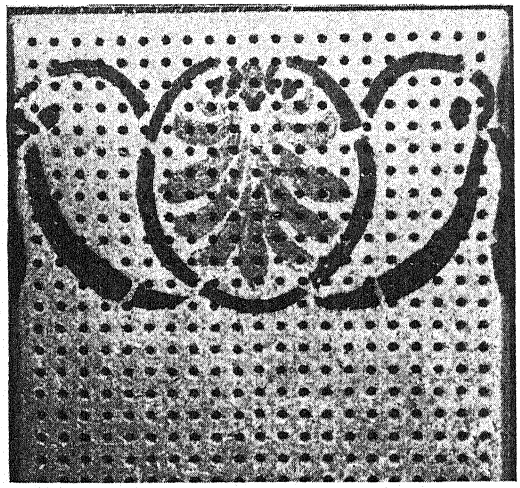


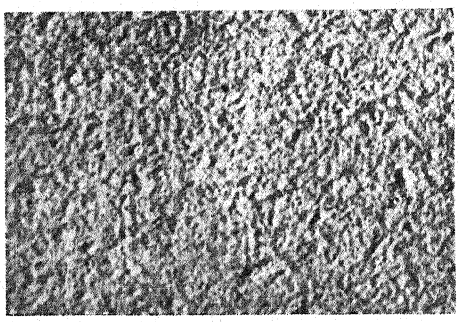
Exposures. The shortness of the exposure necessary at a given stop might prove to be inconvenient; therefore, stop down a further two or three points to lengthen the exposure to a more convenient figure. When deciding on the best exposure to give, and also the right stop, consider the



COPIES OF COLOURED WORK. Two examples of photographic copies of works widely differing in character. The lower photograph is a copy of a painting in full colours and was taken with a Sinclair " Una " camera. The upper picture was obtained with a Leica camera. In each case the lighting and exposure were adjusted to give full and accurate colour values, and there is no loss of definition in the change from colour to monochrome

Upper photo, E. Leitz (London); lower photo, W. R. Ayling, Ross lens, f11, 2 sec., Ensign Ultra Pan. film





TEXTURE AND DETAIL. Above, reproduction of acoustical tile taken with a Leica in half-watt lighting. Right, copy of wall texture taken with a Sinclair "Una" in daylight and with one Nitraphot. lamp. Exposures respectively were 1 sec. at *f*6.3 and 1/3 sec. at *f*11

question of vibration. If there is a possibility of vibration, open up the lens and give a short exposure. If many copies are to be made and the work is to be carried out in a building where vibration is present (such as in some factory premises), the object to be copied, together with the camera, may be mounted on a bench which is in turn isolated from the building by sponge rubber mats placed beneath the bench. This in principle is the method practised by process block-makers to isolate their cameras and the object pictures from the surroundings.

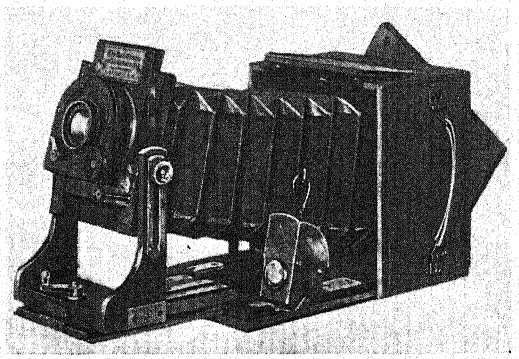
Focussing. It is always advisable to use a magnifying glass to ensure perfect focussing, a glass of the type where the glass lens is fixed at the end of a tube is best, as this excludes any light except that coming through the lens. The magnifier should be moved about over the focussing screen, and the corners should be examined most carefully. If the centre portion is sharp but the edges are blurred, it is a sure indication that the negative plane and the object plane are not parallel.

As a makeshift, an enlarger bench can be utilized for copying, removing the enlarging lantern and adapting the camera in its place. In the case of copying sets for miniature cameras the manufacturers usually supply a table showing the focussing distances to cover various sizes of objects, together with distance from lens to negative surface and from lens to object picture. This dispenses with visual focussing altogether, but great care must be observed to get the distances correct to a millimetre, because there is no margin for errors in focus. Tables have been published showing the relative exposure needed for various degrees of reduction or enlargement when copying (*see* Magnification). These concern low magnification work rather than straightforward copying. For those who wish to check up on their exposure factors the following formula will enable the "copyist" to arrive at a figure which indicates the increase over normal exposure, where such increase is needed:

The Exposure Factor equals the distance from image to lens squared, divided by the focal length of lens squared.

It is sufficient in ordinary practice to measure the light reflected from the object picture by means of a photo-electric cell type of meter, making allowance in the case of copies which show little reduction in size.

Copying Processes. Methods of copying documents and printed matter in facsimile such as the Photostat, Playertype, Recordak and Rutherstat are discussed under the heading Recording and Copying Apparatus.



SPECIAL ADVANTAGES. The Sinclair "Una" is a high-grade camera with features which make it especially suitable for copying work. The rising front movement has a very great range and the double extension is sufficient to allow objects to be copied the same size

COPYRIGHT LAW FOR THE PHOTOGRAPHER

W. T. Creswell, K.C.

An understanding of the existing laws relating to photographic copyright is important to all photographers whose activities with the camera extend beyond the mere taking of snapshots for private purposes. The subject, which is somewhat complex, is here explained by a legal expert. In addition to dealing with such aspects as ownership of copyright and infringement, other lesser known points of the law are defined and discussed

COPYRIGHT in effect means the sole right to produce or reproduce a particular work, or any substantial part of it, in any material form.

Under the provisions of the Copyright Act, 1911, a person is entitled to copyright in respect of his original works only, whether they are published or unpublished.

Period of Copyright. The period of copyright is, as a rule, the life of the author plus a period of fifty years after his death; and the period commences from the moment when the work is completed. By Section 21 of the Act the period in respect to photographs and the product of any process analogous to photography is fifty years from the making of the original negative from which the photograph was directly or indirectly derived.

Copyright is personal property and may be transferred by will, assignment or licence in writing, or by operation of law.

Infringement of Copyright. It is an infringement of copyright if any person, without the consent of the owner of the copyright, does anything which the latter has the sole right to do as owner of it.

The Subject of Copyright. Any original literary, dramatic, musical or artistic work may be the subject of copyright if it is first published within "the copyright area," which is, broadly, the British Dominions, or, in the case of an unpublished work, if the author of it had the necessary qualification of citizenship, or residence within the copyright area, at the time the particular work was made.

There can be no copyright in a mere copy, or in ideas or opinions, though it is possible to have a copyright in the form in which an idea or an expression is expressed. For instance, there is no copyright in a system of indexing (see Cartwright *v.* Wharton (1912) 25 O.L.R. 357), or in an idea for a picture-postcard (see McCrum *v.* Eisner (1917) 87. L.J. (Ch.) 99). Nor is there any copyright in news; but there is copyright in the form in which it is expressed (see Springfield *v.* Thame (1903) 89 L.T. 242).

What 'Artistic Work' Includes. The term "artistic work" includes works of painting, drawing, sculpture and artistic craftsmanship, including architectural works of art, and engravings and photographs. As regards photographs, this includes photo-lithographs and work of any kind that is produced by a process which is similar to photography. For instance, a cinematograph film can not only be protected in respect to copyright as an "artistic work," but may be protected also as a dramatic work. In this connexion it may be pointed out that the original sketch of a design capable of being registered under the Patents and Designs Acts of 1907 and 1919 is not protected under the Copyright Act, though a photograph of the actual article which is made from the design is protected by the Copyright Act. A picture, engraving, or photograph, therefore, which has a value in itself as apart from the article to which it is to be applied, is protected, it would appear, under the Copyright Act. In Con Planck, Ltd. *v.* Kolynos Incorporated (1925) 2 K.B. 804, an action brought by the plaintiffs for the infringement of copyright, they claimed to be assignees from the authors of two sketches for cut-out advertisement show cards, representing a pierrot and pierrette, with large faces and small bodies. These sketches were shown by the author to the defendants with the defendants' name upon them with the view of being used by them for advertisement purposes. At the suggestion of the defendants the colour of the costumes of the figures was changed from mauve to green and yellow; the colour of the lettering of the defendants' name was also changed from red to green and yellow.

The defendants ordered about 10,000 of the sketches altered, at a price which gave the author a very considerable profit. Subsequently the defendants obtained a number of sketches from sources other than the plaintiffs. Neither the plaintiffs nor the author had registered the sketches as designs under the Patents and Designs Act, 1907. It was held: (1) that under Section 5 (1) (a) of the Copyright Act, 1911, the defendants were the first owners of the copyright in the original sketches, as the sketches were ordered by and were made for them for valuable consideration, and were engravings; (2) that the sketches were designs which were capable of being registered under the Patents and Designs Act, 1907, and as they were used as models or patterns to be multiplied by an industrial process, the Copyright Act, 1911, by reason of Section 22 (which is to the effect that if designs are capable of being registered under the Act of 1907 the Act of 1911 does not apply), did not apply to them, and that as the sketches had not been registered as designs under the Act of 1907, the plaintiffs could not succeed.

Mr. Justice Sankey said: "It is said that each of these sketches is an 'artistic work,' and therefore there is copyright in them by Section 1 (2) (c) of the Act (of 1911) because by Section 35 'artistic work' includes works of painting . . . and photographs. The real question involved therefore is this: Is the sketch in question a 'design' which should be registered under the Patents and Designs Act, 1907, or is it artistic work which is entitled to the longer protection which is given to such works by the Copyright Act?"

It is a question of law, therefore, whether any work is or is not registerable as a design under the Patents and Designs Acts, 1907 and 1919; whereas an original sketch of a design capable of being registered under those Acts will not be protected under the Copyright Act, a photograph of the article made in accordance with the design will be protected under the Copyright Act.

The Owner of the Copyright. In general the author of any work is the first owner of its copyright—that is, the person who first writes, composes, compiles or draws the work. The person who was the owner of the original negative of a photograph from which the photograph was directly or indirectly derived at the time when such negative was made is deemed to be the author of the work. But there are some instances in which the author is not the first owner, as when a plate or other original of an engraving, photograph or portrait is ordered, and made for valuable consideration because of that order. Here in the absence of any agreement to the contrary the person who gives the order, and not the author of the work, is the first owner of the copyright therein. And a plate or other original includes any stereotype or other plate, stone, block, mould, matrix, transfer, or negative used for printing or reproducing copies of the work. And an engraving includes an etching, lithograph, wood-cut, print and other similar works. And a photograph includes photolithographs and any work produced by any process analogous to photography (see Sections 5 (1) (a) and 35 of the Copyright Act, 1911).

In Cases of Contracts of Service. When the author of a work was in the employment of some other person and under a contract of service or apprenticeship, and the work in question was made whilst in the employment of that person, then that person by whom the author was employed is, in the absence of any agreement to the contrary, the first owner of the copyright. A contract of service is one in which the person is subject to the commands of his master as to the manner in which he shall work. When such a person does a work in his own time and not in the course of his employment by a master, the copyright vests in that person and not in the master.

Liability of Payment of a Photograph. When any person orders a photograph of a photographer there is an implied contract between that person and the photographer to pay for the original should no copies be ordered of it, the copyright being his who gives the order. Whereas if a photographer, in the first instance, requests permission to take the photograph, it depends on all the circumstances whether there is such an implied contract to pay, though no doubt the ownership of the copyright is with the photographer. Nowadays photographers when inviting important persons to visit

their studios for the purposes of a photograph being made, usually make it clear that no obligation to pay is imposed on the invitee and that the copyright remains with them.

Photographs of Public Monuments. It is no infringement of copyright in any work of sculpture or artistic craftsmanship permanently situated in a public place or building to make or publish paintings, drawings, engravings, or photographs of such works. Nor is it an infringement of copyright in an architectural work of art to make or publish paintings, drawings, engravings, or photographs of such a work, provided they are not in the nature of architectural drawings or plans. An " architectural work of art " is given as meaning " any building or structure having an artistic character or design, in respect of such character or design, or any model for such building or structure." (See Section 2 (1) (iii) Copyright Act, 1911.)

Assignments. A person may assign his copyright. It must be assigned in writing by the owner of it or his duly authorized agent. The assignment may be by letters, provided a proper contract is made. The assignment may be wholly, as when an amateur sells his photograph to the press and, of course, the copyright of it ; or partially, as when he sells the right to reproduce the photograph only, but retains his copyright of it. An assignment or any part thereof vests what right is, in fact, assigned in the assignee so that he becomes the owner of the right, and may take action against persons who infringe or who have infringed it.

Twenty-five years from the death of any author the copyright in any work assigned or otherwise than by will, revests in and devolves upon his legal representatives as part of his estate.

Offences. A person commits an offence if he fraudulently signs or otherwise affixes, or fraudulently causes to be signed or otherwise affixed, to or upon any painting, drawing, or photograph or the negative thereof, any name, initials, or monogram. Also an offence is committed by any person who fraudulently sells, publishes, exhibits, or disposes of, or offers for sale, exhibition, or distribution, any painting, drawing or photograph, or negative of a photograph, having thereon the name, initials, or monogram of a person who did not execute or make the work. Similarly an offence is committed by a person who fraudulently utters, disposes of, or puts off, or causes to be uttered or disposed of, any copy or colourable imitation of any painting, drawing, or photograph, or negative of a photograph, whether there is subsisting copyright therein or not, as having been made or executed by the author or maker of the original work from which such copy or imitation was taken.

Where the author or maker of any painting, drawing, photograph, or negative of a photograph made before or after the passing of the Fine Arts Copyright Act, 1862 (see Section 7) has sold or otherwise parted with such, and an alteration is afterwards made therein by any other person by addition or otherwise, any person commits an offence if he, during the life of the author or maker of the work, and without his consent, makes or knowingly sells or publishes or offers for sale such work or any copies of such work so altered, or of any part thereof, as or for the unaltered work of such author or maker.

All alterations must be material alterations, and of such nature as might affect the character and reputation of the artist for it to be sold as his work. Furthermore, it is sufficient to establish an offence if it can be shown that the act of altering, etc., was committed intentionally. (See Carlton Illustrators *v.* Coleman & Co., Ltd. (1911), 1 K.B. 771.)

In every instance there must be a selling or publishing in conditions in which, to the knowledge of the seller or publisher, there is made expressly or by implication a representation that the author is the author of the work sold or published in the form in which it is sold or published. It may not, however, be essential that the author's name be upon the work sold ; the mere fact that the general style is well known, and that the work sold will suggest to some minds that it is the plaintiff's work, is not sufficient and will not amount to a representation that it is the unaltered work of the plaintiff (per Tomlin J. in Preston *v.* Raphael Tuck (1926), Ch. 667.)

Penalties. A person aggrieved by a breach of the provisions already referred to is entitled to a sum not exceeding £10, or not exceeding double the full price, if any, at which all such copies, altered works, etc., have been sold or offered for sale ; and

all such copies, altered works, etc., are forfeited to the person, or to the assignees or legal representatives of the person, whose name, etc., has been fraudulently signed or affixed thereto. But the penalties are not incurred unless that person was living at or within twenty years next before the time when the offence was committed.

A plaintiff in an action to recover penalties may obtain an injunction to restrain the future breach of the provisions above mentioned.

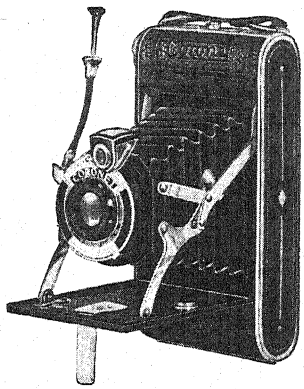
CORONET CAMERAS. This Birmingham firm, the Coronet Camera Co., manufactures a wide range of cameras of the box and folding types at prices ranging from 3s. 11d. to 10s. 6d. for the box models and from 15s. to 48s. for the folding types.

The box cameras all take the popular $3\frac{1}{4} \times 2\frac{1}{4}$ in. roll-film, and of these the Xcel and Every-Distance models are fitted with a mask enabling the user to take 16 pictures size $2\frac{1}{4} \times 1\frac{5}{8}$ in. if desired, instead of 8 pictures $3\frac{1}{4} \times 2\frac{1}{4}$ in. The Every-Distance 16 camera is fitted with a built-in colour filter (*see* Box Camera).

Among the folding cameras marketed by the Coronet Co. is one, the Coronet Vogue, which enters the " miniature " class, taking pictures 50 × 30 mm., yet costs only 15s. Streamlined, with no extraneous fittings, and finished in bakelite, the Vogue weighs only six ounces, and is a true vest-pocket camera. Six exposure films costing 9d. can be obtained for the Vogue camera, and accessories include a portrait attachment and a colour filter.

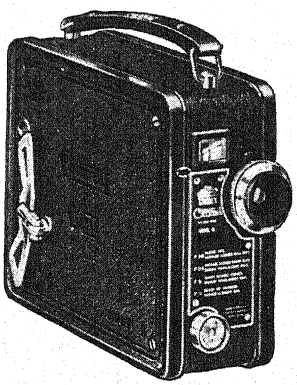
Among the usual folding roll-film cameras made by the Coronet Co. are two fitted with anastigmat lenses, one working at a maximum aperture of *f*7.7 and the other at *f*6.3. These cameras are fitted with three-speed shutters (1/25, 1/50, and 1/100 sec.), as well as the usual Time and Bulb.

In addition to still cameras, the Coronet Camera Co. markets a motor-driven 9.5-mm. cine camera, selling at the remarkably low price of 75s. The lens is a fixed-focus *f*3.9 anastigmat of 27-mm. focus, with portrait attachments available for distances of 6–12 and 4–6 feet. Instead of being propelled, as in most other cameras, by reciprocating claws, the film is moved by a sprocket wheel, the teeth of which engage the perforations. The gate has two swinging arms, one of which holds the film up to the camera mask, while the other holds it in contact with the intermittent sprocket. The clockwork motor will run 30 feet of film at one winding. There is an automatic film footage indicator, and the view-finder is of the built-in direct vision.



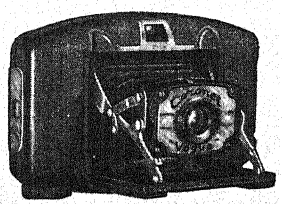
Coronet 'Anastigmat' folding model. Fitted with *f*6.3 lens

The Coronet projector for 9.5-mm. films is supplied in two models, one hand-driven and the other motor-driven. The film is continually in mesh for three frames, and so is not liable to damage at the gate, while a minimum of flicker is ensured by the use of a specially designed intermittent motion with a ratio of 9 : 1. The spools will accommodate up to 400 feet of film.



Coronet cine camera for 9.5-mm. films

Among the photographic accessories marketed by the Coronet Company is a moderately priced titling device for cine films, consisting of a polished hardwood stand with a collapsible grooved title holder, with lamp sockets at either side, and a cine stand provided with a hinged door so that it can be used as a receptacle for accessories. Specially made 60-watt half-silver lamps are supplied as extras, but the supplementary close-up lens for the camera is included with the titling outfit.



Coronet 'Vogue' model, taking 50 x 30 mm. pictures

COST AND ECONOMY IN AMATEUR PHOTOGRAPHY

Bernard Alfieri, Jr.

Facts concerning the expense involved are of immediate concern to both the prospective amateur photographer and those who have already taken up photography as a serious hobby. Here Mr. Alfieri discusses this matter of outlay and shows how by discrimination in purchase of material and sound methods of working, waste and unnecessary expenditure can be easily avoided

PHOTOGRAPHY need not be expensive, but the actual cost of any photograph is so closely linked with the practice of sound economy that before making any definite assertions on actual expenses, some remarks on true economy may be advantageous.

The first consideration for almost any photographer who has to decide the best means of making his hobby cost less, is to find possible causes of waste. Even the most careful photographer wastes some material. This should be investigated, and reduced to a minimum.

A careful consideration should be given to the material which produces results that are wanted, or are good enough to keep. Some photographers waste more material than they convert into good negatives or perfect prints. It is the waste that causes photography to be expensive. As a rule those amateurs who complain most about the cost are those who waste the most material.

Good Technique Gives Economy

There are two causes of wasted material. Haphazard technical methods are productive of much waste, because the photographer often makes a number of exposures in the hope that one or the other will be correct. The same photographer makes print after print, none perfect, because he fails to follow the simple rules which give good results.

It is the custom in these days to use small cameras with a view to economy in negative materials. Apart from other considerations, the small camera user is often very liberal in the use of film, comforting himself with the thought that in the small sizes film is cheap. This may be true for individual exposures, but when a very large number are made for one or two that turn out well, the cost of the negatives may be higher than would be the case with larger sizes.

The latter seem to give a greater certainty in working, and the higher cost of material tends to make the photographer more careful, both as to the choice of subject and in ensuring that a good negative will result. But in the case of the skilled photographer, the smaller sizes can be very economical.

On the other hand, miniature negatives do not offer cheaper results than popular sizes such as $2\frac{1}{4}$ inches square, or $3\frac{1}{2} \times 2\frac{1}{2}$, under any conditions. The actual cost of miniature work lies not so much in the price of the negative material as in the subsequent treatment. Contact prints in the larger popular sizes answer most requirements, and enlargements need only be made from chosen negatives, whereas with the miniature negative, enlargements are usually necessary in the first place.

True and False Economy

Particularly in processing, the miniature film can be spoilt by false economy. It is an interesting fact that some firms will develop a 35-mm. film of 36 exposures for about 1s. 6d., but if individual attention and fine grain are required they may charge up to 5s. If the general quality of a film is spoilt, either by unsuitable processing or the use of cheap chemicals, it is too late to select one frame from the whole length and try to improve the quality in the printing.

If we analyse the various expenses, from the initial price of the film to the final cost of finishing a good enlargement, it is surprising what a small percentage of the total sum is actually spent on film, and if we again consider the enormous quantity of film both amateurs and professionals alike can afford to waste each year, it will be realized how cheap photography can be. In processing, it is false economy to spoil the whole result and waste a valuable negative by using stale chemicals. Developers, as well as hypo, are cheaper than sensitized material, and it is false economy to attempt to economize the one at the expense of the latter.

Many photographers seem reluctant to expend a single sheet of paper for the purpose of making test exposures. Yet to do so would be real economy, and in the end much more satisfying results would ensue.

It always pays to purchase high-grade materials. For instance, let us consider and price the following example of low-grade materials:

For Cheapness	s.	d.
One spool of inferior film, six exposures	1	0
One packet of cheap developer		4
One packet 6 sheets cheap bromide paper		6
Developer for paper		4
	2	2

Assuming all six exposures were good, and no paper wasted in printing, each print has cost only a little over 4d. But what is the quality of the print? First of all, it cannot be better than the film could produce, and secondly, though the paper might have given passable results off an excellent negative, when used in combination with one of poor quality the chances of obtaining really good results are few.

Moreover, without fresh hypo, some of the prints may be stained. Compare these results from cheap materials with those obtainable when truly first-class material is selected.

For Quality	s.	d.
One spool of good quality film	1	6
Best possible developer		6
One packet full grade paper	1	0
Developer for paper		4
	3	4

Allow a penny for hypo and we have the chance of six excellent prints for under 7d. each.

In professional photography there are two sides to the costing; firstly, materials and varying charges, and, secondly, constant figures such as overhead charges, time, etc.

If the time is calculated to include a reasonable percentage of overheads and unproductive charges, at so much per hour, plus a share of reasonable profit, combined with the particular expenses of any one commission, it will often work out at under two shillings for materials and over one pound for time—allowing for full grade materials. It follows that the cost of poor quality work may show a saving of about 6d. on materials, offering a charge of 21s. 6d. as against 22s.

The real cost of photography, from the amateur point of view, can only be estimated from the pleasure obtained for each shilling expended, and if ordinary care is taken in the selection of subject matter and waste is reduced to a minimum, there are few hobbies that can offer such value for money.

COSTS AND COSTING IN COMMERCIAL PHOTOGRAPHY

W. G. Briggs, F.R.P.S.
Of Studio Briggs, Ltd.

There exists among many who are starting photographic businesses or who are working in a small way the common error of arriving at their selling cost in a most casual manner. This article, by an expert commercial worker, indicates ways in which this casual price fixing can be substituted by an accurate form of costing

BEGINNERS in commercial photography usually know the fundamentals of what constitutes "costs," but too often this slight knowledge is dangerous; they will ascertain the plate and paper cost, they will compute the time the work is going to take them, add on an amount to cover their overheads, and decide they can sell at a certain established figure. But this is certainly not enough.

Where have they made their mistakes? They have taken the actual cost price of the basic materials, overlooking the cost of much material that is used only in small quantities and overlooking an allowance for wastage. They have fixed in their minds a price per hour at which they consider they can profitably work, and on this they have assessed the time the job will take, overlooking such factors as time taken interviewing or travelling, standing or waiting, illness or holidays. Following this, they have taken their rent and their rates and have added an inadequate amount to cover these items, or have entirely overlooked the hundred and one other items that contribute to make up the sum total of overheads and on-costs.

It is exceedingly difficult to apply an efficient costing system to a photographic

business, owing to the wide variation in the type of work an average professional man is called upon to undertake and, more than anything, to the important part played by individuality. In so far as photography is a profession, it cannot be costed as one would cost a purely manufacturing concern, and certain aspects of the business charges must of necessity be estimated as closely as one can. Although it is possible to arrive at the cost of everything, costs rarely have any relation to the return which may be obtained where professional ability is involved.

The cost of a piece of work refers to the total cost of: (*a*) Labour; (*b*) Materials; and (*c*) Fixed charges and on-costs, the whole of which must be included. The last is something which will differ materially in different businesses, and affects the total cost largely by the volume of work handled.

RECEIVED ..... WANTED ..... No.

Date..... Date .....

Time ..... Time .....

CUSTOMER .....

.....

SUBJECT..... CUSTOMER'S O/No. .....

OPERATOR ..... ASSISTANT .....

INSTRUCTIONS

.....

.....

.....

.....

.....

.....

Flashes ..... Overtime .....

Sashas ..... Expenses .....

NEGATIVES Used

1/2

1/1

10×8

12×10

Chargeable

1/2

1/1

10×8

12×10

PRINTER

Neg. Nos.	Neg. Size	Contact Prints	Enlarged Prints and Size	Particulars of Toning, Mounting and Special Work, etc.

..... MODELS ..... BLOCKING OUT..... Hours Initials

PROPERTIES..... RE-TOUCHING..... Hours

WORKSHEET FOR A PHOTO BUSINESS. In the commercial studio a rigid system of working must be applied to avoid losses due to mistakes in instructions, and waste of material. Here is a typical worksheet of the kind adopted by the professional photographer in which all details are recorded for individual jobs

It will be necessary for each operative to have a worksheet (as illustrated here), which will include all instructions regarding the job, and spaces provided for the insertion of all basic materials used, such as plates or films, paper, mounts, and for the inclusion of operational times, with a special space for extras chargeable, such as flashlights, blocking out time, etc. It should be noted that a good sheet reserves space also for special instructions and printing memorandum.

Review the following imaginary Trading and Profit and Loss Accounts:

TRADING ACCOUNT

For the year ended December 31st, 1937

Dr.	£	*Cr.*	£
To Stock 1st Jan., '37	54	By Sales	4,031
Purchases ..	765	Stock 31st. Dec., '37	61
Wages	1,020		
Gross Profit c/d	2,253		
	£4,092		£4,092

PROFIT AND LOSS ACCOUNT

For the year ended December 31st, 1937

Dr.	£	*Cr.*	£
To Rent and Rates	382	By Gross Profit b/f	2,253
Lighting and Heating	39	Discounts received	55
Office and General Expenses ..	295		
Advertising ..	109		
Insurance ..	12		
Postages and Telephone	32		
Salaries ..	526		
Commissions ..	212		
Legal and Audit Expenses ..	40		
Subs.&Donations	7		
Discounts allowed	81		
Repairs and Renewals	58		
Depreciations ..	72		
Bad Debts ..	41		
Nett Profit ..	402		
	£2,308		£2,308

NOTE.—It is assumed that the owner of the business is charging a salary to the accounts, and the profit represents return on capital invested.

The items in costing usually covered direct, namely (*a*) Labour and (*b*) Materials, appear in the Trading Account as Wages (*i.e.* production wages) and Purchases, respectively. The only other item affecting gross profit on sales is the opening and closing stock. This is usually a fairly constant figure, tending to grow only with the business.

The items covered under the other heading, (*c*) Fixed charges and on-costs, appear in the Profit and Loss Account. Some, such as Rent and Rates, are known fixed charges; others, such as Office and General Expenses, Postages, etc., are unknown, and these have to be estimated for by (1) percentages calculated with the benefit of past accounts and adjusted by any known variations; or, if prior accounts do not exist, by (2) a carefully prepared and calculated budget.

It must be stressed that a system of costing should presuppose a certain standard of work and that the operations are performed in an economical manner with the correct equipment, and one must base the selling price by including in the total such obvious items as Materials, Wages, productive and non-productive, Rent, Rates, the Fixed charges and all the reserves and charges that a prudent man must consider before estimating the percentage of profit.

Cost and Selling Price. The interest in costs is in order to know at what price to sell reasonably. It is impossible to fix a selling price for the various types of commercial photography which can and do vary from the very poor to the superlative.

It would be just as impossible to fix a standard price for millinery, tailoring, confectionery, and the hundred other articles of consumption. But just as it is impossible to produce a hat, a suit or a pound of sweets below a certain economic price if a standard of quality and suitability of purpose are to be maintained, so it is impossible to produce a photograph of a given type and quality below a certain price. To fix a basic price for all grades of work is not possible, but it is possible to indicate factors that have to be taken into account when arriving at a selling price. The cost must be calculated on a sound basis, allow for reasonable contingencies, and then show a margin of profit.

There are various grades of commercial photography from the purely mechanical to the purely creative, and the problem of fixing a selling price becomes more difficult the higher up the scale one goes. It is relatively easy to fix selling prices for such work as copy photographs, mass and mechanical printing, lantern slides, etc., and in practice prices for these classes of work are fairly stable and will not vary very much. This is due largely to the fact that these grades of work conform to standard conditions which vary but little. Individuality scarcely enters into this type of work.

P.P.A. Schedule. It is possible to go further in minimum selling prices without the consideration of individuality entering too strongly. There is a field of straightforward record and catalogue work in the studio and outside which does not call for anything more than competence and technical ability; there is also hand printing and the making of controlled enlargements, reductions, etc. To this section the Professional Photographers' Association issue a schedule of suggested minimum prices, extracts from which are shown. These prices have been arrived at after much investigation and are strongly recommended as a minimum basis.

	8½×6½	10×8	12×10
Attending premises within photographer's own immediate district, taking one photograph and supplying one print ..	15s.	20s.	25s.

	$8\frac{1}{2}\times6\frac{1}{2}$	10×8	12×10
Subsequent photographs up to five, taken at the same time, each	10s.	15s.	20s.
Extra prints, unmounted, each	2s.	2s. 6d.	3s.

Over six photographs taken at the same time will be charged at second line rate.

Photographs taken at the studio, second line rate.

Charges for enlargements from existing negatives *not* including charge for taking photographs :

$8\frac{1}{2}\times6\frac{1}{2}$ in. ..	3s.	20×16 in. ..	12s. 6d.
10×8 ,, ..	3s. 9d.	24×20 ,, ..	18s. 6d.
12×10 ,, ..	4s. 6d.	30×24 ,, ..	27s. 6d.
15×12 ,, ..	7s. 6d.	36×28 ,, ..	40s.

These prices are recommended for adoption by photographers generally as fair and reasonable charges for a good standard of photographic work.

Clients demanding specially skilful work would require to be charged double or more the above prices for the work to be profitable.

An additional charge will be made in the following circumstances :

(1) For difficult, dangerous or delayed work.
(2) For use of portable electric or flashlight.
(3) For actual out-of-pocket expenses in travelling, etc. (When a photographer uses his own car, 3d. per mile all the way is a fair *minimum* charge.)
(4) For retouching or blocking out.
(5) For work outside business hours.
(6) Toned prints 25 per cent. extra.
(7) Surrender of negative when required : $6\frac{1}{2}\times4\frac{3}{4}$ in., 12s. 6d. ; $8\frac{1}{2}\times6\frac{1}{2}$ in., 15s. ; 10×8 in., 20s. ; 12×10 in., 25s.
(8) For mounting photographs.

Minimum prices for simple copying at the studio :

$6\frac{1}{2}\times4\frac{3}{4}$ in.	5s.	10×8 in. ..	10s.
$8\frac{1}{2}\times6\frac{1}{2}$,, ...	7s.	12×10 ,, ..	13s. 6d.

Individual Work. Next comes work where individuality begins to take a prominent part. It may only be a single catalogue illustration, but it will be so arranged, treated and lighted, that in the resulting photograph there is the stamp of individuality. It may be more or less a straightforward exterior of a building, but by the careful selection of viewpoint, the use of the most suitable lens, and by choosing the most suitable time of the day, a photograph bearing unmistakably the mark of the individual is the result.

This type of work naturally places itself in a higher grade, the price of which will vary more or less in correct proportion to the skill of the person who produces it.

There is a further category of work which depends almost entirely upon the individuality of the photographer ; it may be a fashion or advertising study, a creative still-life subject, a dramatic industrial photograph, or a photo-poster or mural, each of which will be so individual in expression that a knowledgeable person will in all probability be able to recognize in the work the peculiar creative ability of the photographer who produced it. This type of work will present its own problem for correct charging, which will be a rather different one from simple costing, and will be governed by the law of supply and demand and the special fitness of the photograph for the purpose intended.

These types of work will not preclude a method of costing, but as by far the larger part of the selling price will be based on the individual photographer's time and reputation, this aspect will be determined on the value the market places upon his work.

While it is possible to arrive at " terminal costs," no guidance other than basic principles can be offered. By " terminal costs " one refers to the cost of an individual job.

In recent years problems in costing have arisen in the form of the introduction of the miniature camera. It is not, however, to be anticipated that because very much smaller films or plates are used, this effects an economy. The real reason for the introduction of the super miniature is the utility of the instrument. It can do what a large and cumbersome camera cannot do ; it can work at great speeds, but as is usual whenever one gets a delicate and complicated instrument, it requires more skill in handling in order to obtain the desired results. Nor does one's balancing of costs finish here, but one's negatives also require greater skill in handling afterwards.

Any book-keeping textbook will tell how to keep cost accounts, but a photographer must apply these to his own particular conditions and, unlike manufacturing concerns, he will find that he will have to do more averaging. In professional photography, unfortunately, everything is not always a success and also the enterprising and progressive individual must always be experimenting. All these costs have to be paid. If methods and results are right—photography is a field where one will always be able to obtain a price that shows a good return.

One final word : do not consider you can spend the profits earned in any one year—the wise business man will make a special reserve to meet unexpected contingencies.

CRIMINAL INVESTIGATION WITH THE CAMERA

Olaf Bloch, Hon. LL.D., F.I.C., Hon.R.P.F.S.
Chief Chemist, Ilford, Ltd.

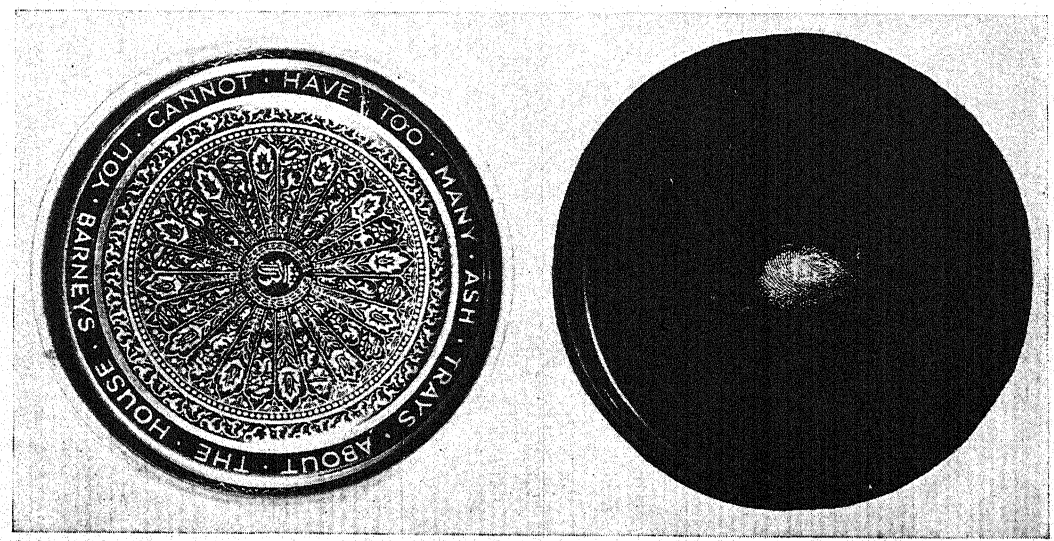
For many years the camera has been extensively used in the detection and prevention of crime, and with the advance in science and photographic technique the value of photography in this work has grown to a remarkable degree. How the police authorities obtain irrefutable evidence by means of the camera in dealing with various crimes is described by a leading authority on the subject

MODERN criminal investigation depends for its success on many branches of science, and not least among these is photography, which, apart from its use in exact recording, is also of value in the detection of fraud, the study of stains and other markings, the identification of the structure of materials, and other purposes.

Photography in criminology may be said to be divided into two kinds: (*a*) Routine—portraiture of prisoners, finger-print photography, recording the scenes of crimes, motor and other accidents, copying, etc.; and (*b*) Special—photographic analysis, forgery detection, photo-micrography, cinematography, ultra-violet and infra-red photography, etc.

In the former kind accuracy is the most important factor. An exactly true likeness of a prisoner is essential, and to this end standard lighting, lens and camera, standard viewpoint and standard sensitive material must be used. Balanced side lighting is necessary since it retains modelling and depth of shadow without distortion. A long focus lens (say of $6\frac{1}{2}$-inch focal length for a quarter-plate camera) also avoids distortion. Viewpoint must be from the eye level of the sitter; otherwise, either the forehead or the chin will suffer apparent enlargement and the whole shape of the face be altered. Panchromatic material is not used in prisoner-portraiture, since, though it produces a beautifying effect in removing skin blemishes, freckles, etc., that would be pleasing in an ordinary photograph, this is obviously to be avoided in a likeness that may depend on those very features for identification. Dark-skinned or negro subjects appear pale on panchromatic material, a patent disadvantage in criminological photography.

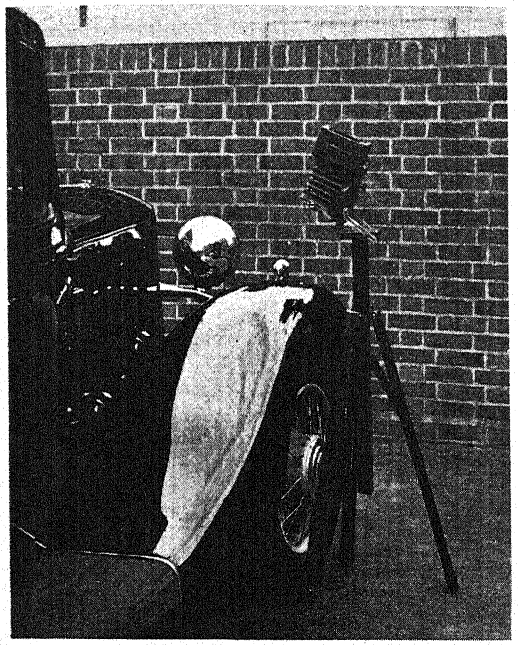
Where the scene of a crime or accident is being recorded, a small lens aperture (but not smaller than *f*16) is used to make the details as sharp as possible. Further, in these cases, several photos should be



CLUE UNCOVERED BY THE CAMERA. Left, an ashtray photographed by normal methods. The most minute inspection fails to reveal any trace of finger-prints. Right, the same ashtray photographed after being dusted with powdered anthracene and made to fluoresce in ultra-violet light. This fluorescence only was photographed, so that the finger-print alone stands out
Courtesy of Ilford, Ltd.

taken from varying angles to show all the details of the scene in their correct perspective and position.

As for finger-prints, the difficulty mainly lies in the location and lighting of the prints. There are special finger-print cameras for



TELL-TALE MARKS. Polarizing screens are used to avoid reflection when photographs of finger-prints on glossy surfaces are being made. Above, a camera specially rigged to take a photograph of finger-prints on the polished wing of a car. The result is shown on the right

Courtesy of Ilford, Ltd.

recording prints in accessible places and on unglazed surfaces, but in other cases ordinary cameras are used. The final photograph must be black on a white ground; thus finger-prints may be photographed either by the ordinary process, or direct on to negative cards, when a reversing prism or mirror is included in the camera. Where a white powdered print on a dark ground is to be recorded, orthochromatic material is loaded into the dark slide with the emulsion side away from the lens, yielding a laterally reversed negative. From this a diapositive is printed, yielding a white print on dark ground, but still laterally reversed.

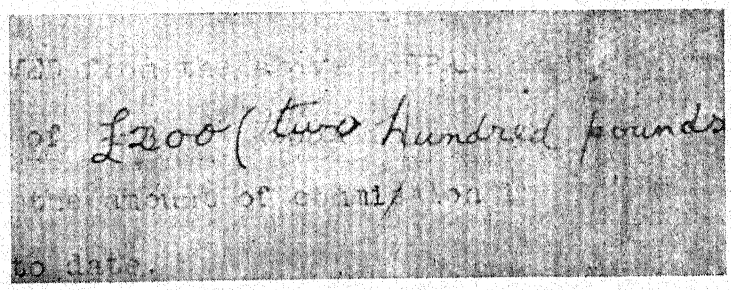


From this transparency the desired black image can be printed normally and will not be reversed.

When photographing finger-prints on glossy surfaces, polarizing screens (to avoid reflection) are used, and faint finger-prints are also brought to light by being made to fluoresce in ultra-violet light by dusting them with such a substance as finely powdered anthracene.

When finger-prints cannot be taken because the skin of the finger has been removed by burning or peeling, the retina of the eye, which also has an individual pattern for every person, may be photographed, and here special ophthalmic cameras must be used.

In the "special" photography division, lie the more interesting aspects of criminological work. Photo-micrography, which is used for the examination of tools or weapons and their imprints, hair, textiles, bloodstains, dust, seeds, etc., has brought many a criminal to justice. Dust found on the scene of a crime, for instance, has been shown to be largely lead, ultimately bringing the crime home to a plumber; or iron, helping to trace a murder to a mechanic. Photo-micrography is also useful in revealing forgeries, though in this respect ultra-violet



WHAT THE EYE CANNOT SEE. A photograph, taken with ultra-violet rays, of a document that had been tampered with. The word three and figure 3 have been "washed" and the word two and figure 2 substituted. Due to the rays, the "washed" writing appears in dark outline against the fluorescence of the background

From "Some Persons Unknown," by H. T. F. Rhodes

photography is more often employed; this is due to the fact that two objects which may be of the same colour visually may differ in the degree to which they fluoresce in ultra-violet light, as mentioned when dealing with finger-prints. Chemical erasures on forged documents often fluoresce freely. In these cases the subject is illuminated by a mercury vapour lamp the light from which passes through a filter which only transmits ultra-violet and not visible light.

Infra-red rays have the power to penetrate opaque objects to a certain degree, and infra-red photography has obvious advantages in dealing with forgeries, etc. But carbon completely absorbs infra-red rays, so that markings in lead pencil or Indian ink (both forms of carbon) do not photograph by these methods, while alterations in ordinary writing ink are readily revealed. Infra-red photography is also valuable in identifying dyed materials, since different dyes react differently to the rays.

Cinematography has chiefly been useful in the recording of street-betting and similar crimes. Radiography (or X-ray photography) has proved extremely valuable in the detection of such factors as structural defects and the existence of hidden foreign bodies, and in photographing delicate mechanisms such as those inside a time-bomb, or such objects as works of art that are suspected of being forged. An example of its use is the testing of pearls by X-rays, which reveal their structure and thus enable distinction to be made between real and cultured pearls. X-ray photography has the great advantage that it does not destroy or affect in any way the object photographed, and can thus be checked by repetition.

CRUISING: HINTS FOR GOOD PHOTOGRAPHS

W. A. Seymour Lincoln

The variety of subjects encountered on a cruising holiday makes this form of vacation very popular with the amateur photographer. Difference of climate, however, can prove a pitfall to the inexperienced when judging exposure times, and helpful hints on this and other matters connected with cruising photographs are given in the following article

See also Holiday with the Camera

THE different atmosphere and more brilliant sun found abroad are apt to deceive the amateur photographer from the point of view of exposure. Contrary to what one might suppose, the danger in taking photographs in sunny climates with a clear atmosphere is to under-expose them, and the photographer is frequently disappointed with results of his work that show heavy black shadows and hard sunlight.

The photographer who may be tempted by the vivid sunshine into giving short exposures should remember that there is very little light in these shadows, that the lighting is extremely uneven and that consequently exposures must be adjusted accordingly. The reason for this greater lack of actinic value in these shadows, compared to those made by the sun in England and other countries with similar climatic conditions, is that there are no mists and few clouds to scatter, reflect and diffuse the light.

The following comparisons with exposures given in England at the seasons stated will serve to show how necessary exposing for the shadows evens up the time allowed for both countries, notwithstanding the intensely bright sun.

Norway, Sweden and Denmark. April to August, O (same as in England).

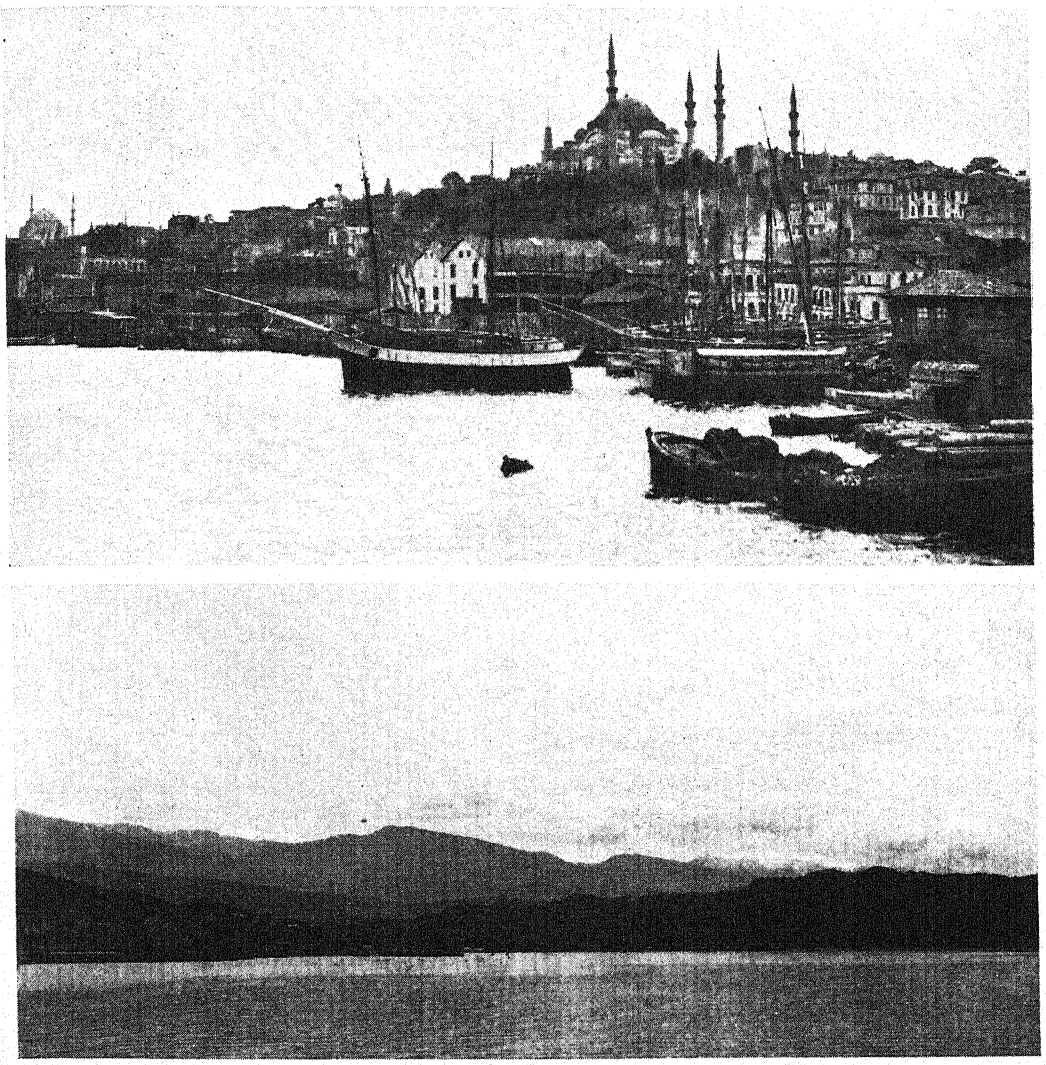
Mediterranean (S. Europe), Japan, U.S.A. Northern States (New York) and Southern Canada. March to September, O. October to February, $\frac{1}{2}$.

Madeira, Canary Islands, North Africa, China, U.S.A. Southern States, S. California, Florida. April to August, $\frac{1}{2}$; September to April, $\frac{1}{3}$.

(These figures can only be approximate, and the use of an exposure meter is advised.)

Naturally, there are sometimes clouds in the sky, and for these a light yellow filter, such as the Wratten K1, should be used. With this an increase in the exposure is necessary, amounting to approximately two and a half times in the case of orthochromatic material, or about one and a half times it used with panchromatic stock (*see also* the article Filters).

Exposures on Board Ship. These are equally deceptive and the excessive



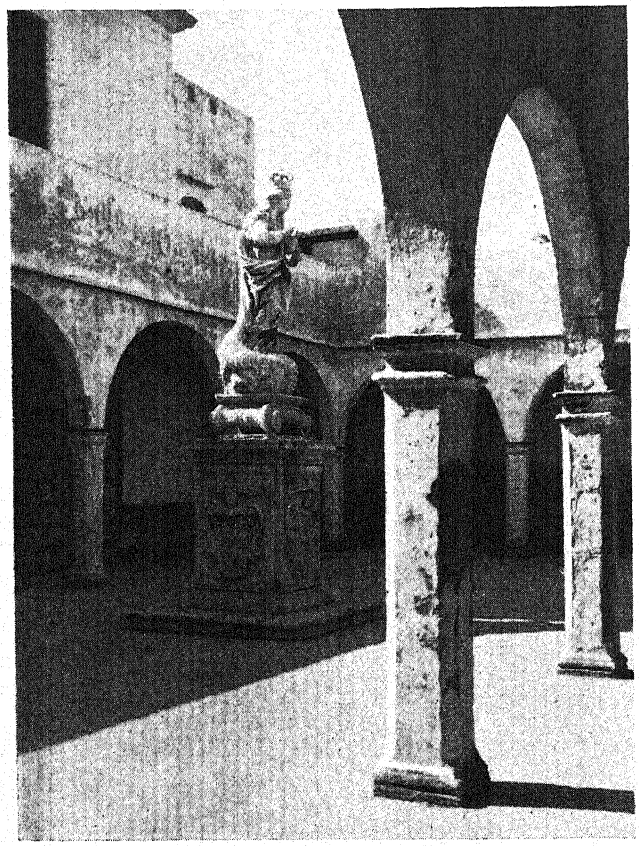
HARBOUR VIEWS FROM THE DECK. The photographer should not be misled into taking pictures of the shore at too great a distance. To the eye a view may appear impressive and full of form and colour, but as a subject for the camera it will be nearly useless. Compare the lower picture shown here with the upper photograph. While one is a mere expanse of water and sky, the other, made as the ship approached the quayside, has interest, detail and contrast

Photos, Seymour Lincoln

amount of sun should not be taken as a guide. Disappointing results of groups and people taken on board ship are almost always due to heavy shadows on the faces which make the features practically indistinguishable. This is partly due to the fact that hats are more usually worn and the resulting shadows not allowed for, and also to the fact that the photographs are taken when the sun is directly overhead.

For more interesting and certain results, remember to allow for such shadows and wait until the sun is more at an angle. It is not necessary to give long exposures; simply resist the temptation to give excessively short ones.

Time exposures on board ship are not advocated because of the vibration, though this varies with the type of ship, of course. Not that time exposures are impossible; a perfectly sharp photograph of a ship's saloon taken while the boat was in motion was given an exposure of half an hour. Never rest the camera itself on the rail of the ship, for it transmits every vibration faithfully.



variety of subjects come before the camera, but by using discrimination regarding the photographic possibilities of a scene, a large percentage of disappointments will be obviated.

When judging the pictorial value of a subject, eliminate the part that colour plays in the scene, or, better still, translate the colours in your mind's eye into terms of grey. It is a good idea to view the subject through a piece of blue-tinted glass. Then ask yourself, " Is the subject still worth taking or has the interest gone out of it with the colour ? " Take notice of form and design ; if the line of a subject is good it will stand without colour.

Photographs of street scenes in the native quarters are typical of this type of pitfall. The sun and the riot of colour made by the native garments form a pretty picture, but without the colour only the squalor remains, though, of course, such a photograph has its interest, though not a pictorial one.



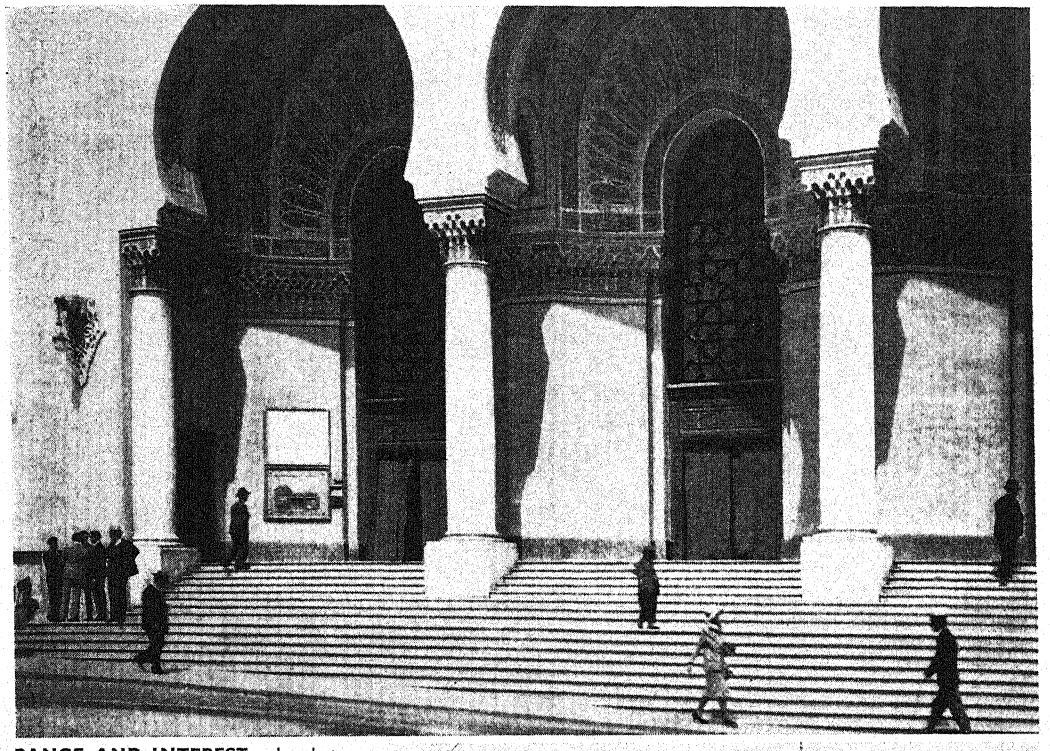
COURTYARD AND STREET SCENES. Above, courtyard of Capucin Convent, Cadiz. Details in the shadows have been well rendered by allowing sufficient exposure. Right, a native quarters snap marred by under-exposure and out-of-focus figure in foreground. These are two faults to avoid in taking street scenes, especially the first, in countries of strong sunshine and deep shadows

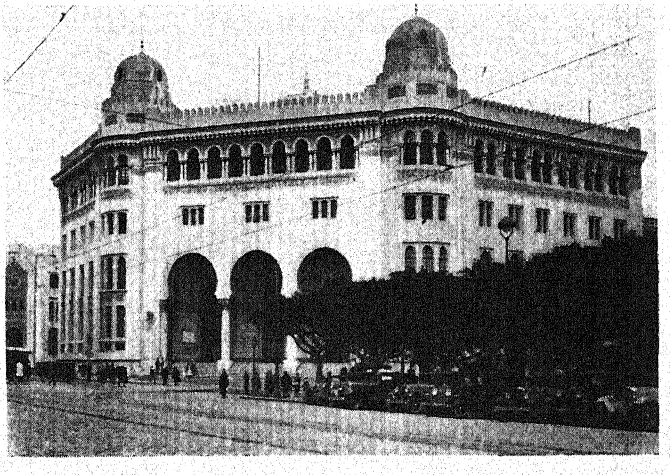
Photos, Seymour Lincoln

Classification of Subjects. This is also an important factor, especially as subjects are more likely to vary on this type of holiday. A simple plan is to divide the types mentally into three, as follows: Open Subject, Normal Subject, and Heavy Foreground Subjects, the last class also including close-ups and groups near the camera.

Taking 1 for the normal, give one-fourth for the open subject and from 2 to 4 for the subjects grouped under " heavy foreground." The normal subject would be an average view with buildings, groups of trees, or mountains in the immediate distance, or an open street scene. Open subjects would include seascapes, distant panoramas, etc.

Choice of Subject. The amateur photographer on his or her first cruise is apt to snap fast and furiously as an innumerable





RANGE AND INTEREST. In photographs of buildings a close-up is generally more interesting than the picture postcard view, as these two pictures show
Photos, Seymour Lincoln

Form need not be restricted to the subject ; light and shade can provide interest in the design.

Alleyways, such as are found in Algiers, Tunis, or Casa Blanca, are especially tempting to take and, indeed, make interesting as well as pictorial subjects if caught with the sun at an angle, making a pattern of contrasts. But these same subjects taken with the sun overhead and given a normal exposure at, say, *f*11 or *f*16, simply result in a patch of sky. For narrow streets and alleyways use a wider aperture and a filter for the sky if necessary.

A photograph of an interesting building is better if the foreground is broken by a tree or some other not too obtrusive object.

Studies of natives are more attractive if you can get them going about their work and not grinning into the camera.

Ships on the horizon are almost always a failure from a photographic viewpoint. What looks quite large to the eye is on a film merely a pinprick on an expanse of water.

Interesting Shots. Moonlight at sea is an attractive subject, and the effect of moonlight can easily be given to a photograph taken in the light of the sun. Point the camera towards the sun when it is bright (but partially obscured by light cloud to avoid halation) and under-expose for such a subject.



GOING ASHORE. Incidents such as the one seen in the above picture, in which passengers are shown going ashore on arrival at a foreign port, find a place in a photographic record of a pleasure cruise. Apart from their pictorial value, they form a link in the series of photographs the traveller secures, and make his record complete

Photo, Seymour Lincoln

of places visited, take groups and photographs of the passengers on board and on shore. It will be seen, then, that he will have little time to give to any individual developing, printing and enlarging, so that should special treatment be required for some subject, it is advisable to wait until the return home. It is a good plan, however, to have the first few exposures developed as a guide, and if notes have been made as to aperture and time and other details given for each of these, the necessary corrections can be made for the future.

A very slight over-development of the film will aid the deception, but it is not very important and will make the printing more difficult. The prints of "moonlight" subjects should be made rather darker than is usual.

Photographing figures against the sun is another way of making an unusual effect, and this applies to statues on buildings as well as to animals and human forms in a picture. A normal exposure will give a silhouette, but some detail in the form is also very effective, and this is achieved by increasing the time or aperture.

For serious amateurs a longer focus lens greatly widens the scope for attractive shots, especially with a reflex camera, and an even greater advantage lies in the possession of a telephoto lens.

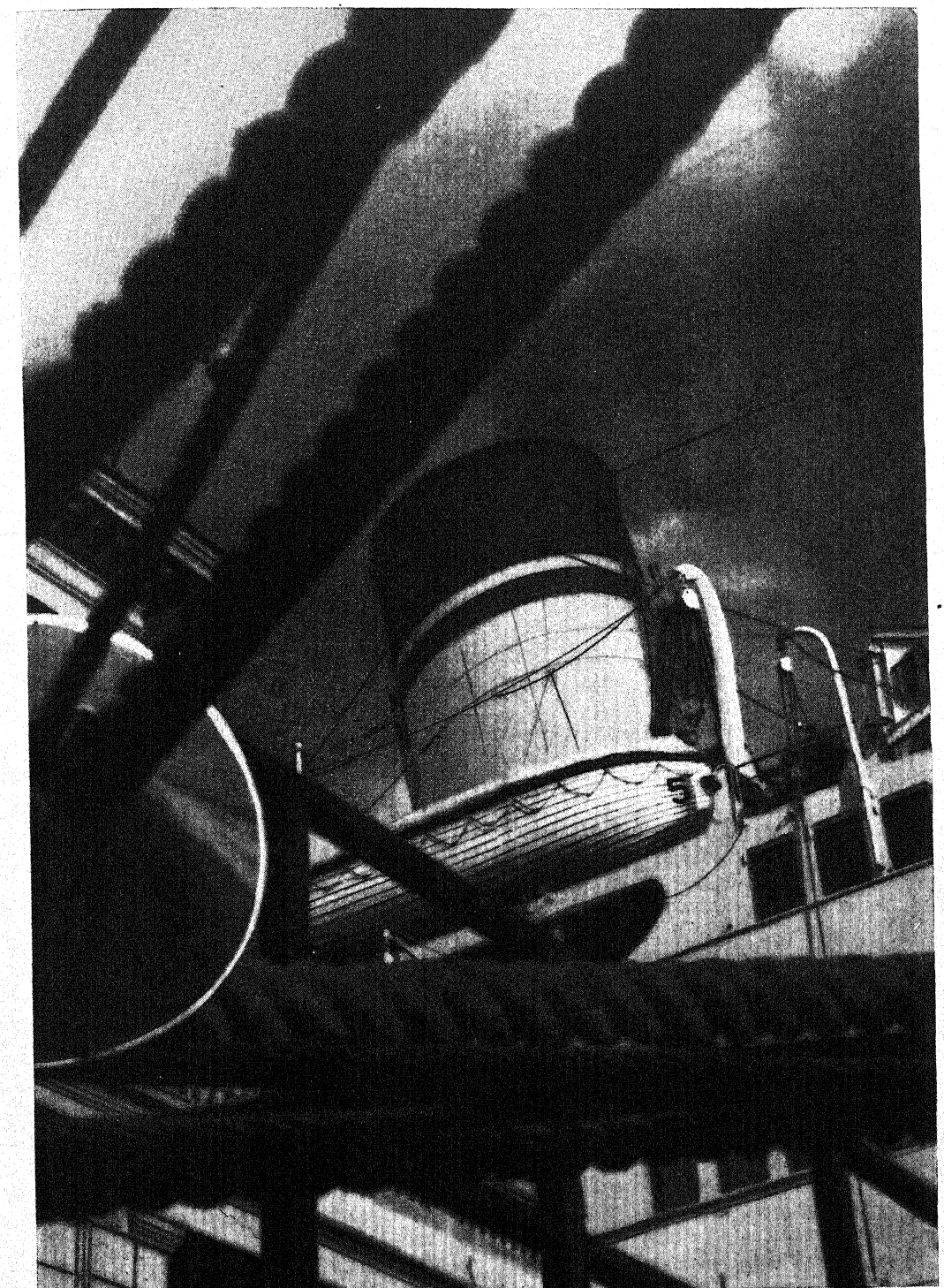
Patterns on the deck of sun and shade, a coil of rope and similar objects which might seem to have no pictorial value, assume a shape to the discerning eye, especially if the photographer remembers that a very low viewpoint might be just as intriguing as a high one.

Photographers will probably find that they can buy all they need from the ship's photographer, who will also develop and print their snaps. In addition, part of the ship photographer's job is to make pictures

CURVE, CHARACTERISTIC. Prior to 1891 development was regarded as a difficult art, in the exercise of which much could be done to remedy deficiencies and errors in exposure by tinkering with the developer. This theory was exploded by the investigations of Hurter and Driffield, who showed that the tonal range of a negative was determined solely by the exposure and was unalterable by development, save that it was softened or accentuated by a shorter or longer development time.

Identical plates were exposed at a fixed distance from a constant light-source and developed simultaneously in similar developers. A graph was then established, on the ordinate of which was marked the densities, measured by a photometer, while the abscissa was marked off into the logarithms of the exposure times. (Logarithms, and not actual times, were used to keep the graph within bounds for extreme limits of exposure times.)

When the graph was plotted it was found to take the form of a curve which included three main portions: the first, a pronounced curve with concavity uppermost, called the region of under-exposure; then a straight line portion, the region of correct exposure;



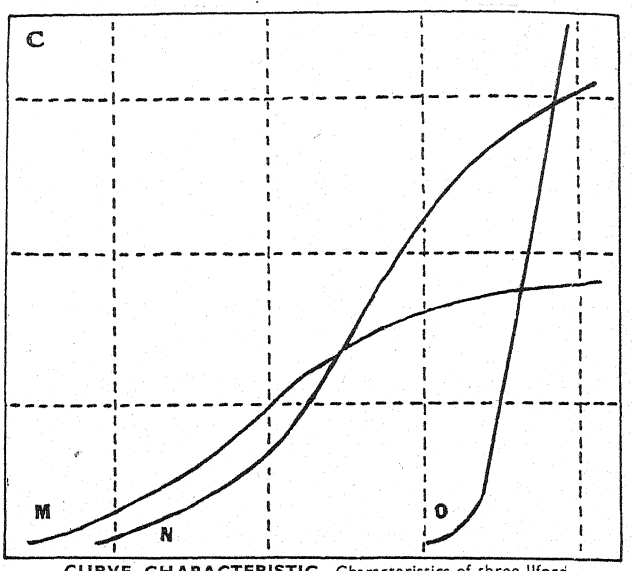
SYMBOLIC OF THE SEA. An original and significant note is touched in this powerful photograph taken at the dockside. The smoking funnel, lifeboat, davits and hawsers in massive silhouette in the foreground speak plainly of the sea and ocean travel

Photo, Lynx

and finally another curve with its convexity uppermost, this being known as the region of over-exposure. In this region the density, after attaining its maximum, then diminishes, *even though the exposure time is still further increased.* This is the curious phenomenon of solarization (*q.v.*) which is rarely observed in practice, as sufficiently long exposures for this to take place are unusual.

If the experiment is carried still further, the curve will be found to rise once more, and several successive maxima and minima would be obtained.

This curve, which formed the basis adopted by Hurter and Driffield for the measurement of the speed of an emulsion, is called the " characteristic curve " of that emulsion, and the underlying theory and its applications are dealt with in detail under Development : Applications of the Theory ; Gamma ; Negatives, Density and Tonal Values ; *and* Prints, Density and Tonal Values.



CURVE, CHARACTERISTIC. Characteristics of three Ilford plates (see text)

The accompanying diagram shows the characteristic curves of three Ilford plates.

M is a Golden Iso Zenith. It responds to a short exposure (its H. & D. speed is 1400). Its maximum density is comparatively low. It is therefore suitable for portraiture and other subjects requiring a long scale of tones from the shadows to the high-lights, but without excessive contrast.

N is a Special Rapid. It is not so speedy, but soon rises into the " straight," and will give great density and contrast if required. It is a good all-round plate for landscape, etc.

O is a Process film. It is very slow, and piles up great density. It is suitable for contrast subjects only, such as copying line drawings. For this purpose it easily gives clear film, and a density of over 3—a density which transmits only 1/1000th of the light passing through the clear film.

All of which amounts to this. According to characteristics we must select a sensitive material to suit our purpose, and we must so expose and develop it as to get the range and extent of densities which will produce a negative suitable for its purposes, whatever they may be.—*W. L. F. W.*

CUSTOMS AND THE CAMERA

This article contains useful advice on the subject of Customs Regulations for those who contemplate taking cameras with them on a holiday abroad. As Customs restrictions, however, vary in different countries from time to time, the traveller is advised, before setting out, to make inquiries from the foreign consulates of the countries concerned

A BELIEF has grown up that once a camera of foreign make has found its way into England with or without payment of the legal tariff, it is once and for all exempt from further payment of duty, and that on bringing it back into England at the expiration of a holiday it is sufficient for the owner to prove to the Customs that the camera was in his possession before he went abroad. It has thus become customary to advise those who are taking a camera away on a holiday abroad to find a Customs officer at the port of departure, and to obtain from him a certificate that he has seen the camera.

Since the imposition of a general tariff, the Customs examination at the ports has necessarily become more rigorous, and the position needs clarifying.

In the first place, it is necessary to realize the position of the Customs officer when he

is confronted by a passenger carrying an expensive camera of foreign manufacture. That camera may have been imported in the ordinary course of trade by the manufacturer's agent in this country ; in that case it may be assumed that duty has been paid on it.

On the other hand, it may have been imported by a private person and that private person may have paid duty upon it ; or he may have smuggled it through in his pocket without declaring it. He may, however, have been allowed to bring in the camera free of duty because he had had it in his possession and use abroad for over a year ; in that case the free admission of the camera would be conditional on the owner undertaking not to sell it.

Lastly, it may have been admitted free of duty when it was not entitled to be so admitted because the owner deceived the Customs ; for example, by falsely pretending that he was merely in transit through this country and was not coming here to stay.

Now, if the camera is still in the possession of the first purchaser, who therefore knows all its history, the Customs officer's task is a comparatively easy one. His difficulties commence when the camera has changed hands, and its present owner knows nothing about its previous history.

The duty on foreign cameras is high, and there is no doubt that many cameras, particularly those of the expensive miniature type, do get into the country free of duty when, if the true facts had been known, they would have been required to pay it. Obviously the mere proof of previous importation cannot be accepted as evidence that the camera is entitled to admission on re-importation without payment of duty.

Exact Proof of Payment of Duty. The fact that a Customs officer may have been shown a camera by its owner before the latter went abroad, and may have issued a certificate that he has seen it (out of courtesy, since the issue of such a certificate is not part of his official duty), does contribute something to the knowledge of the previous history of the camera and to that extent is helpful to the officer who examines it on re-importation. But the belief that such a certificate is a valid passport to free passage through the Customs is a fallacy, for in law it remains liable to duty if this has not already been paid.

So many cameras which have improperly escaped duty on first importation are caught on a second or even third entry into the country, that the Customs authorities may insist, in certain cases, that nothing short of proof that duty has already been paid can be accepted as entitling the camera to free passage through their barrier.

It must not be thought that the Customs authorities are unreasonable ; they are often content with something far short of strictly legal evidence that duty has been paid. In cases where the passenger has bought his camera new from an agent or dealer, one of the most helpful documents that he can carry with him is the receipt giving particulars of the original purchase. This should show the date of purchase and serial number of camera and lens, and if the original has been mislaid most dealers will supply a duplicate or will write a letter setting out the facts of purchase.

Where it is impracticable to get in touch with the dealer it is advisable to communicate with the head office of the maker's agents in this country, giving full particulars of camera and lens and asking whether the camera was imported through their agency and, if so, whether they will be so kind as to give the writer a letter assuring him that duty was paid on importation.

The above covers the case of cameras already in their owners' possession. To those who are contemplating purchasing a new camera it may be mentioned that Messrs. Leitz, the makers of Leica cameras, issue a certificate with every camera they sell in this country, stating that duty has been paid on it. This certificate will not necessarily be accepted by the Customs authorities as legal proof of payment of duty, but it may be assumed that for all practical purposes it will ordinarily serve to free the holder from trouble at the Customs barrier. Similarly, the guarantee issued on request to customers of Zeiss Ikon, Ltd., will be acceptable to the Customs.

Duty on Second-Hand Cameras. Those who have bought cameras of foreign manufacture second-hand from dealers, private advertisers and others, are in a somewhat more difficult position. Those who

have bought from dealers can only rely upon the dealer to supply them with evidence of the camera's previous history. Very much the same procedure must be followed by the photographer who buys from a private person. Either he must have the duty receipt or a full statement of the circumstances in which the duty was not paid. Indeed, in the absence of the actual duty receipt, and particularly when the original importer is not known, we are strongly inclined to advise him (if he intends to take it abroad) not to buy at all, although he may, if he likes, approach the London agents in order to see whether the camera was originally imported through trade channels.

One thing is certain, and that is that if he buys a camera "blind," knowing nothing of its previous history, and takes it abroad with him, he runs a very grave risk of being called upon to pay the duty on return to this country, even though he had bought at a duty-paid price. It may be hard on him in a sense; but the old Latin tag, *Caveat emptor* (Let the buyer beware), is still the law of the land and photographers would do well to remember it.

CUSTOMS AND CINE CAMERAS AND FILMS

The following notes concerning the Customs regulations regarding sub-standard cinematography apparatus and films are compiled by permission from 'The Amateur Cinematographer's Diary'

Sub-standard cinematograph apparatus taken out of this country by passengers for their own use and brought back again by them is admitted duty free if the officers of Customs and Excise at the port of landing are satisfied as to the circumstances. It is not necessary that the evidence produced should be in a particular form, but any evidence that can be furnished, *e.g.* an invoice showing when and where the apparatus was purchased would be fully considered. In certain circumstances a declaration as to the facts may be required from the passenger on a form which the officer will supply.

Cinematograph films, even though previously taken out of this country, are liable to duty on importation after exposure abroad, but as a concession sub-standard films are admitted duty free provided that the officers are satisfied that the quantity is reasonable and that the films are being imported by private owners for personal use.

Cinematograph cameras and projectors bought abroad and imported into this country are liable to duty at the rate of 40 per cent. *ad valorem.*

Cinematograph films imported for the purpose of the exhibition of pictures or other optical effects by means of a cinematograph or other similar apparatus; blank film, on which no picture has been impressed, known as raw film or stock, including photographic sensitized sheets or strips of celluloid or other similar material of a length of not less than 12 feet, whatever the width, full duty, $\frac{1}{3}$d. per linear foot of the standard width of $1\frac{3}{8}$ inches; preferential duty $\frac{2}{3}$d. Cinematograph films of other than standard width are assessed by converting their length into terms of linear feet of the standard width of $1\frac{3}{8}$ inches.

Positives, *i.e.* films containing a picture for exhibition, whether developed or not, full duty, 1d. per foot; preferential, $\frac{2}{3}$d. per foot.

Negatives, *i.e.* films containing a photograph, developed or not, from which positives can be printed, 5d. full, $3\frac{1}{3}$d. preferential.

Travellers abroad are often tempted by the lower prices of photographic goods which prevail there and sometimes attempt to import them into this country without paying any Customs Duty thereon, hence it is much in point to mention that the maximum penalty for smuggling is *three times the amount of the duty and confiscation* of the offending article. The full penalty is frequently levied.

Films cannot be sent abroad to an English address without payment of duty, but they can be sent for processing and re-export if a special concession has been granted to the film manufacturers by the Customs. A film cannot be returned to England from a foreign processing station without payment of duty. In sending films from one country to another it is important that parcel post be used and that the contents of the package be declared. Other forms of post (letter post, sample post, etc.) cannot be declared, and film sent by these means will be liable to confiscation and fines may be levied.

CUSTOMS REGULATIONS ABROAD

Concerning the Entry into Certain Countries of Still and Cine Cameras and Films

FRANCE

Exemption from payment of duty is accorded to: Two cameras, provided they are of different makes; twelve plates *or* two roll-films *or* two film-packs; one sub-standard cine camera; two rolls of film for cine camera. Only one camera is permitted duty-free import in addition to a cine camera.

GERMANY

Cameras, cine cameras and films are admitted duty-free if they are carried by tourists for their personal or professional use during their journey, or if they are sent to them in advance for this purpose or forwarded to them subsequently.

New articles of this kind are admitted free of charge as travelling requisites only if they were already in the tourist's possession abroad and if it may be supposed, judging by the quantity and nature of the articles, that they are intended for personal use during the journey.

The decision as to what quantities of new articles may be admitted free of charge is left to the Customs officers.

BELGIUM

Used photographic apparatus carried by tourists is admitted free of duty without Customs formalities. When the apparatus is new or has the appearance of being new a deposit of the duty (15 per cent. *ad valorem*) and the luxury tax (9 per cent. of the duty-paid value) must be made. This deposit would be refunded on re-export. Photographic plates, films (roll-film, pack-film, etc.) and sensitized paper imported at the same time as the photographic apparatus for which they are intended are admitted free of duty in the following quantities: Twenty-four plates; four roll-films or film-packs of six exposures, or three roll-films or film-packs of eight exposures, or two roll-films or packs providing twelve exposures.

Unexposed films for cinematographic apparatus is liable for duty as follows: Positive film 0.17 franc per metre, negative film 0.34 franc per metre, both plus a luxury tax of 9 per cent. of the duty-paid value.

AUSTRIA

Travellers are allowed to take one roll-film and one sub-standard cine film.

SWITZERLAND

Exemption from payment of duty is accorded to: One used camera and twelve plates or two roll-films; one used cine camera and one roll of film. Duty is levied on new cinematographic apparatus, but if a temporary import permit (*passavant*) is obtained from the Customs authorities the amount paid is refunded when the apparatus is re-exported.

SPAIN

Articles imported by bona-fide tourists are admitted into Spain on deposit of the duty normally payable. This deposit is returned to the tourist provided his stay does not exceed three months. It is necessary that the tourist on entering Spain should be in a position to indicate the Customs House through which he proposes to leave Spain.

PORTUGAL

Cameras, including cine cameras carried by passengers, as well as films in small quantities, are exempted from payment of import duties.

CZECHOSLOVAKIA

Used cameras and twelve plates or one packet of films are admitted duty-free.

U.S.S.R.

Tourists are permitted to bring cameras with them into the Soviet Union, but only one of these articles for each family. They are admitted free of duty, but must be entered on the tourist's passport by the Customs authorities at the frontier, and must be taken out by the tourist on his departure. They must not be given to any other person for his use, either on payment or free of charge, nor presented as a gift unless the Customs duty has previously been paid. Films must be processed and submitted to censorship before leaving the country. The processing plant handles only negative film.

HOLLAND

Cameras imported by foreign tourists for their personal use and taken out of the country on their return are generally admitted without a demand for security for Customs duty being made. If, however, the Customs authorities have doubt as to whether the articles are for the personal use of the importer, or as to whether the goods will be re-exported and the person concerned objects to paying import duty for the goods in question, a transit passport for a maximum period of six months may be issued against deposit of the duty. After the Customs authorities have received proof of re-export the deposit is returnable.

SWEDEN

Cameras, including cine cameras of the Cine-Kodak type, carried by tourists are admitted free of duty, without being subject to deposit of duty or guarantee.

There are no regulations with regard to the number of camera films which may be admitted free of duty. This would be at the discretion of the Customs officer in accordance with what he considered a reasonable supply for the personal use of the owner.

NORWAY

It is understood that cameras, including cine cameras of the Cine-Kodak type, and films therefor, are permitted to enter Norway duty-free when they are brought in by travelling foreigners. In general, a declaration is required from the person in question to the effect that the articles are only intended for his personal use during a short stay, and will again be taken out of the country.

LATVIA

Used cameras and sub-standard cine cameras and the respective films, are admitted free of duty.

ITALY

Cameras, including cine cameras of the Cine-Kodak type, introduced into Italy by tourists are admitted duty-free on condition that such articles have been used. One spool or pack is allowed to be imported free in the apparatus, but additional films for cameras or cine cameras are liable to duty. Standard film (35 mm.) must be processed before leaving Italy.

GREECE

Small cameras can be imported by tourists free. There are no provisions regarding the amount of films which may be admitted.

POLAND

Visitors must deposit the duty for their cameras on crossing the frontier. This will be refunded on the return journey.

CUT. The basic form of transition from shot to shot in cinematography. When the director orders the cameraman to "cut," he is merely telling him to stop filming. In editing, to cut from one shot to the next is, paradoxically, to join them. The joining of the film strips together is termed splicing (*q.v.*).

The essence of cinema is the selection of salient scenes and actions which severally may be spatially and temporarily dissimilar, and the assembling of them so that the mind accepts without question any gaps in the action, and the imagination supplies and fills in the detail. The shots, however, must be so presented that, although action is greatly curtailed, it is yet smooth-running.

A close shot can follow a distant view of a scene and the audience will accept the juxtaposition of the shots as quite natural. Similarly, a good deal of an action can be omitted provided the angle is changed from shot to shot. The audience will, however, be conscious of this flaunting of the laws of time and space if the cut is too abrupt. It should be a smooth transition—a link—and not regarded merely as a convenient means of getting from shot to shot.

As an example, take the following scene: Two people, some distance apart, are filmed in long shot walking towards one another. If the camera continued turning until they met, the effect would be boring and much film would be used unnecessarily. Cut, therefore, from the long shot to a medium shot, from a different angle, on a point midway between the walkers, showing the scene empty for a second or so. Then they come into the picture and meet. Had they been shown already in the medium shot directly after the cut from the long shot, the jump would have been too marked. As it is, although that second or so in which the scene was empty could not possibly have been sufficient to have allowed them to approach so near, the audience accepts the impossible without question.

Alternatively, the cameraman could cut from the long shot to a medium shot of one of the men approaching the camera, which has temporarily taken the other's place. The latter would then come into the picture, his back to the audience. The effect of this complete change of angle is to establish the reactions of one of the men on meeting.

Cutting on Action. Although in film-making time and space are condensed into filmic time and space, there are occasions when it is necessary to suggest continuous action, *e.g.* A man approaches a door, opens it and walks into another room. If in the first shot he is seen beginning to open the door, in the second (taken from the room into which he walks) he must either be shown coming through the door or the door must be swinging to behind him as he walks into the scene. He must not be shown already in the room with the door shut or the audience will be conscious of the sudden jump forward in time and space. We therefore cut on the action which even so is telescoped, the change of angle drawing attention away from the omission of some of that movement. Some of the action must be shown in both shots; not action in the first and none in the next. —*GORDON S. MALTHOUSE.*

Cutting Cine Film. Editing a motion picture film involves cutting the various scenes or "shots" into separate strips, arranging the latter so that they may be readily identified and collated, and, finally, joining them together to form a continuous reel in which the various shots are of the required length and are placed in the order decided upon by the film editor (*see* Cut). Appliances and methods for "mechanical" cutting are under the heading Splicing Cine Film.

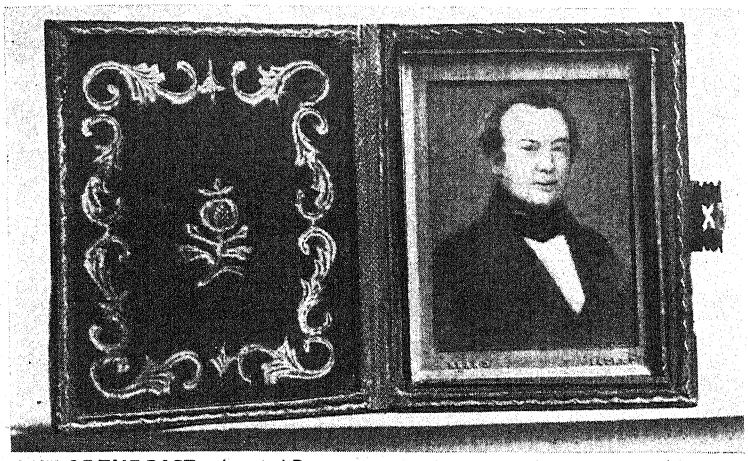
DAGUERREOTYPE: FRENCH PIONEER PROCESS

Named after its inventor, Daguerre, the Daguerreotype is famous as one of the earliest photographic processes. Mr. W. L. F. Wastell, Hon. F.R.P.S., here describes this pioneer method of making photographs, and gives advice on how to restore them

See also History of Photography

The month of January, 1839, is one of the most important dates in the history of photography, as it saw the publication of accounts of two different processes—that of Daguerre in France, and that of Fox Talbot in England. Although Daguerre's process was original and ingenious, it was from the methods suggested by Fox Talbot that modern photography has evolved.

Briefly, Daguerre's process was as follows: A copper plate was silvered on one side, either by rolling a thin silver plate into



OUT OF THE PAST. A typical Daguerreotype portrait is seen here. It was made in 1841 by T. Wharton. The ornate case was necessary in order to preserve the silver surface of the plate, which deteriorates when exposed to light for prolonged periods

contact (as in Sheffield plate), or by "galvanic" plating (electro-plate). The silver surface was meticulously cleaned and polished and exposed in a special box to the fumes of iodine, the correct stage of sensitizing being judged by observation through a sheet of yellow glass. The plate was then exposed.

There was no visible image on the exposed plate; or if there was it indicated over-exposure and the plate had to be cleaned and repolished, for a further attempt. The image was developed by exposing the plate, in a closed box, to the fumes from a bowl of mercury heated by a spirit lamp beneath, with a thermometer to indicate the correct temperature. Mercury was deposited in proportion to light-action on the iodide of silver, so that the highest lights were whitest. Unaltered iodide was removed with hypo, and the plate washed and then dried by heat.

While the lights of the subject are represented by varying deposits of mercury, the shadows are more or less clear polished silver, so that the picture is best seen when turned towards something dark. It is obvious that the subject must be reversed laterally—a serious defect at times, especially in the case of sitters in uniform. A usual size for portraits was 4 in. × 3 in., and the price for each one was about two guineas.

Although the image of a Daguerreotype is extremely susceptible to mechanical damage, there are still many examples of the process in existence, sometimes in perfect condition. The plate was always bound up under glass, and often put into a light-tight case.

But though the image lasts well if not unduly exposed to strong light, the silver surface oxidizes, and the image is more or less obscured by a blue or brown deposit. With care this can be removed. The plate is first unbound (on no account must the surface be touched), and then placed face upwards in distilled water in a clean porcelain or glass dish, and well rinsed by constant rocking.

The water is then poured off, and a solution of potassium cyanide applied—10 grs. to each ounce of distilled water. This solution should be applied in small quantities and frequently renewed. When the image is clear the plate is rinsed in several changes of distilled water, held by a bottom corner with pliers, and quickly dried from the top downwards by holding it almost vertically (back downwards) above a spirit flame or Bunsen burner. It is then rebound.

To copy a Daguerreotype is a somewhat difficult task, owing to the reflecting surface of the silver plate already mentioned. One method is to make a box, blackened inside, with the plate supported at one end, and the lens inserted through a hole at the other. Light is admitted to the plate through openings in the side of the box, close to the plate.

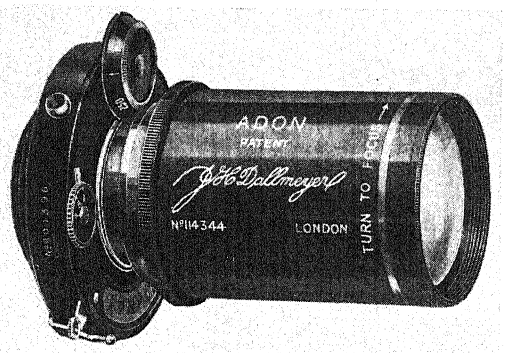
Another plan is to set up the plate facing a dead black screen with an opening to admit the lens. In either case the aim is to have nothing but dark surfaces to be reflected by the plate.

DALLMEYER, LENSES & CAMERAS. For over three-quarters of a century the house of Dallmeyer has been famous for its photographic lenses and apparatus. From the introduction of the Dallmeyer Rapid Rectilinear lens over fifty years ago up to the latest *f*1.5 "Speed" anastigmat, this firm have maintained an enviable reputation.

Among the various lenses marketed by Dallmeyers, the Adon is a particularly well-

known adjustable multiple-focus telephoto lens, which can be used on all sizes of cameras employing a focussing screen, the covering power being limited only by the extension available.

At the same extension as the ordinary lens, the Adon gives three linear magnifications—



DALLMEYER ADON LENS. A variable-focus, telephoto lens designed for use with all types of cameras employing a focussing screen. Besides the photographing of distant objects, it can be used for landscapes, and such subjects as architecture

i.e. an increase in area of nine times. By reason of its simplicity in construction, internal reflecting surfaces are eliminated and brilliant pictures obtained. The New Large Adon is a fixed-separation telephoto lens of large aperture, designed to meet the requirements of photographers who wish for a lens of long focus and large aperture, but have not sufficient camera extension to allow of the use of an ordinary long-focus lens.

The magnification is approximately 2 linear—that is, 4 times increase in area.

A recent addition to the range of Dallmeyer lenses is the Super-Six anastigmat, with an extreme aperture of *f*1.9 and an angle of critical definition of over 50 deg. These lenses are manufactured for both photographic and cinematographic purposes, the latter type with six focal lengths, from 1¼ to 3 inches.

Dallmeyer wide-angle anastigmats can be focussed at an aperture of *f*6.5, so that even in dull interiors local artificial light is hardly ever needed for focussing purposes. Used at the maximum working aperture of *f*11, these lenses embrace a particularly wide-angle field.

The Dallmeyer "Stigmatic" lens is a universal lens with a very wide scope. Combining four lenses in one, it has possibilities far beyond those of most anastigmat lenses. The "Stigmatic" lens is constructed of two corrected components. The front consisting of three lenses, when used alone in its original position—*i.e.* the front of the mount—will give approximately twice the focal length of the complete lens.

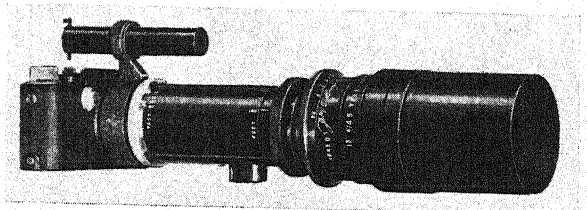
The back combination, consisting of a cemented doublet, used alone in its normal position, will give an increase in focal length approximately equal to half the normal focal length of the complete lens. When using the single components, the lens should be stopped down to about *f*16.

Lenses for Enlargers. Dallmeyer enlarging anastigmat lenses are specially designed for use with horizontal and vertical enlargers, employing half-watt or mercury vapour lighting.

They are manufactured for stock in nine different focal lengths. Greater focal lengths can be manufactured to special order.

Many lenses for sub-standard cine cameras have been designed by Dallmeyers, the accepted standard for normal work being the 1-inch *f*2.9 Triple Anastigmat. For dull lighting conditions there is an *f*1.5 "Speed" anastigmat, and for obtaining large-scale images of distant objects there are cine-telephoto lenses in focal lengths from 1½ to 12 inches, the 12-inch lens giving a magnification of 144 times linear, an increase of 21,836 times in area.

In addition to computing and manufacturing lenses for all types of cameras, the house of Dallmeyer itself markets a very wide range of cameras, lenses and accessories.



FOR HIGH-POWER WORK. Special 12-inch *f*4.5 Dallmeyer telephoto lens fitted to a Leica camera. It provides six linear magnifications. Above the lens is a direct-vision monocular view-finder

The Dallmeyer Speed camera was one of the first ultra-speed pocket cameras on the market, and is still in great demand today. Its lens is a Pentac *f*2.9 and the focal plane self-capping shutter works at speeds from 1/8 to 1/1000 sec. as well as Time and Bulb.

This camera has a rising front and is fitted with a double-frame finder.

The Pentac roll-film camera takes $3\frac{1}{4} \times 2\frac{1}{4}$ in. roll-film, and is fitted with an *f*2.9 Pentac anastigmat of $4\frac{1}{4}$-inch focal length. The Compur shutter gives a range of automatic speeds from 1 sec. to 1/200 sec., and the camera is provided with rising and cross front movements.



Dallmeyer 'Snapshot'

For naturalists and zoologists there is probably no better camera than the Dallmeyer "Naturalist's Reflex." It is a quarter-plate reflex (though other sizes can be obtained to order) fitted with a Grandac rapid telephoto lens.

The telephotographic lens gives an equivalent focal length of 25 inches (635 mm.) with the camera closed—*i.e.* a minimum extension of 6 inches (152 mm.), the aperture being *f*10. The camera has an extra extension of $4\frac{1}{2}$ inches (114 mm.), thus at its maximum extension of $10\frac{1}{2}$ inches (266 mm.) an equivalent focal length of 36 inches (912 mm.) can be obtained with an aperture of *f*14. The naturalist's camera is supplied complete with an extra front, allowing the use of short-focus large-aperture lenses. A focal plane shutter gives speeds from 1/16 to 1/800 sec. as well as Time and Bulb.

For those who require a camera possessing the good qualities of a professional instrument, yet so simple to operate that a novice can use it successfully, the Dallmeyer Snapshot Camera can be recommended.

Unlike the usual form of camera, the lens mount of the Dallmeyer "Snapshot" bears no stop numbers, nor are any actual exposure times marked. The diaphragm mechanism is simply marked "Bright" and "Dull," the former position giving a lens aperture of *f*11 and the latter a full aperture of *f*6.

The shutter is marked "Time," "Slow" and "Fast," the first being used for long exposures (interior scenes, for instance), the second for portraiture and general views, and the third for moving objects. Focussing is carried out by simply rotating the lens until a mark comes opposite the indications "Near," "Medium" or "Distant."

The Dallmeyer *f*6 anastigmat, a four-glass lens of short focus, gives excellent definition and is fully corrected, and this excellent optical equipment, coupled with extreme simplicity of operation, ensures excellent pictures of practically all subjects.

In addition to many other cameras, the firm of Dallmeyer is also the British distributor of the Victor range of cine cameras and projectors (*see* Victor).

DANCE AND BALLET PHOTOGRAPHY

Peggy Delius, A.R.P.S.

After a short historical introduction, this article deals instructively and interestingly with photographing the quickly-moving dancer in the open-air, in the studio and on the stage, with discussion of the problems of lighting, background and focussing

See also Action Subjects : Stage Photography

THE photography of the dance has only a very short history. A branch of action photography, it has depended almost entirely on the more recent technical achievements in photography.

About twenty years ago Hugo Erfurth, of Dresden, was the first to attempt dance pictures with the camera. He confined the dancer to the repetitions of the same movement within a given and very limited space until he had obtained the desired result.

It was, however, Charlotte Rudolph, of Dresden, who became the pioneer of actual dance photography. She was the first photographer to attempt the portrayal of dance in full and unrestricted movement. In comparison with the photographer of today she had many more technical obstacles to overcome. Her work, begun in 1926, will remain outstanding for technical achievement and, above all, for her sensitive and recreative insight into the dance.

The last years have brought rapid technical development of the photographic processes on which action photography depends, and with it the opportunity to those many





SCENES FROM THE BALLET STAGE. The speed of action and the degree of illumination are the two main factors in dance photography. Here are two excellent examples of ballet photographs. The upper picture shows Vera Nemchinova in "Les Sylphides" *Leica III A; Summar lens at f2; Kodak Super X film; developed in Meritol)*; the lower was taken during the performance of Fokine's "Don Juan" *(exposure details as before except for film, which is I.S.S. Pan.).* Each was obtained from the front of the house

Photos, Peggy Delius, A.R.P.S

photographers interested in subjects most characteristically taken in action. The complete understanding of the photographic object is most certainly the basis of successful dance photography. It may seem unnecessary to those who are strangers to action photography to give a definition of the aims of this work. Action photography is concerned with obtaining pictures of typical moments, characteristic both for rhythm and function. Anyone who has attempted to photograph dance will have observed comparatively still moments which are not action. To capture the essence of the subject in movement is the aim of the action photographer. A good picture may be obtained under conditions similar to those obtaining for a still or held moment, but it will not be an action photograph. To give an example. The writer remembers a photograph of a "leap" shown at an exhibition in 1926. It was procured in the following way: The dancer lay down on a dark background material spread on the floor of the studio and assumed as nearly as possible a "leap position." A picture was obtained from the top of a ladder, giving the illusion of a figure moving in space. It is always very difficult to "assume" the pose of correct muscular tension, and therefore this particular picture was not a convincing illusion. This example goes well to prove in the writer's opinion how essentially dance photography is identical with action photography. The peak of a dancer's leap is one of the few exceptions where apparently still moment and characteristic movement coincide. But it does not therefore follow that slow movements are always characteristic. To apply indiscriminately the experience obtained in photographing a single leap to photographing, for instance, dancers in stage productions may lead to disappointing results. Action photography bars pictures of posed movement, and demands of the photographer a keen eye, quick decision and a steady hand. But these qualities must be supplemented by the very essential knowledge of subject.



PHYLLIS BOUTELL. In this action picture, taken outdoors, the rhythm and grace of the dancer at the peak of the leap are admirably expressed. In an open-air photograph of this kind anything but a plain background would spoil the aesthetic effect
Photo, Peggy Delius, A.R.P.S.; Summar lens, f4.5, Kodak Super X film; 1/500 sec.

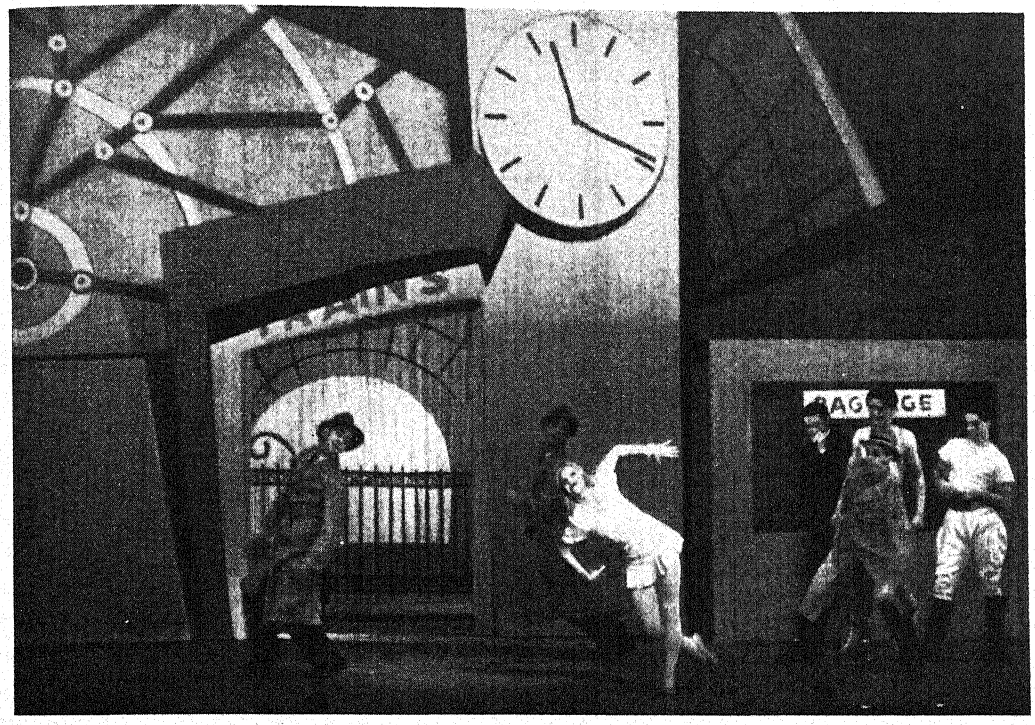
Problems and Solutions. The problems are manifold as will be quickly realized once the great variety of the subject is taken into consideration. Dance photographs can be secured (1) in the open-air; (2) in the studio (or any other suitable confined space); and (3) on the stage. These possibilities will all be governed by two primary factors: the speed of movement and the amount of illumination.

In the open-air the lighting will, as a rule, given a lens of reasonable aperture and



LE LAC DES CYGNES. An example of a dance photograph in which there is good rendering and delicate gradation in spite of the limitations of the stage lighting. The success of the photograph is largely due to choosing a moment when the artists were in static pose

Photo, Merlyn Severn; Contax, f2, 1/25 sec.



MODERN AMERICAN BALLET. Taken during a performance by the Philadelphia Company of Catherine Littlefield's ballet "Terminus" at the London Hippodrome. This action picture is another good example of dance photography carried out with a Leica camera. The combination of wide-aperture lens and coupled range-finder brings this type of work within the scope of the photographer who has both the technical and artistic capacities represented in successful examples of the art

Photo, Peggy Delius, A.R.P.S.; I.S.S. Pan. film, Hypersensitized in mercury vapour; Summar lens, f2; developed in Meritol

moderate weather conditions, not be an obstacle to working at a sufficiently fast shutter speed to get an unblurred and clearly defined image. It will be necessary to watch the position of the sun for lighting effects (and also of the shadows) and the relation of the figure to the background. Many factors of aesthetic value can only be dealt with by avoidance. For instance: a skyline broken up by shrubs, trees, houses, will be detractive to the movement of a leap, giving the impression of less height, and the aesthetic effect may be so unsatisfactory as to spoil any composition.

Once photographic activities are taking place within a building, however large or small the space may be, the problem of lighting assumes a position of major importance.

In the Studio. It is here possible to concentrate light sufficiently powerful to illuminate a given space up to the limit of the electricity meter controlling the supply. The amount of light needed will be dependent on the speed of movement, the colour and reflecting power of the background and the size of the space needed by the dancer. The smaller the actual space used the easier for the photographer. But with decreasing space the amount of action will be strictly limited and dance photography will eventually become impossible.

This gain of controlled lighting and controlled space is offset by difficulties of accurate focussing at fast working speed over comparatively short distances. In practice lenses of high aperture are used for this type of work. The depth of focus decreases as the aperture widens on any type of lens. It follows that the smaller the photographer's distance will be from the dancer the more he will have to contend with the problem of quick and accurate focussing.

On the Stage. Here the question of quick focussing is no longer a problem of real difficulty. It is replaced by a much bigger obstacle: the adequacy of lighting for photographic purposes. The distance of the photographer from the dancer on the stage will usually be well within the depth of focus capacity of the modern high-

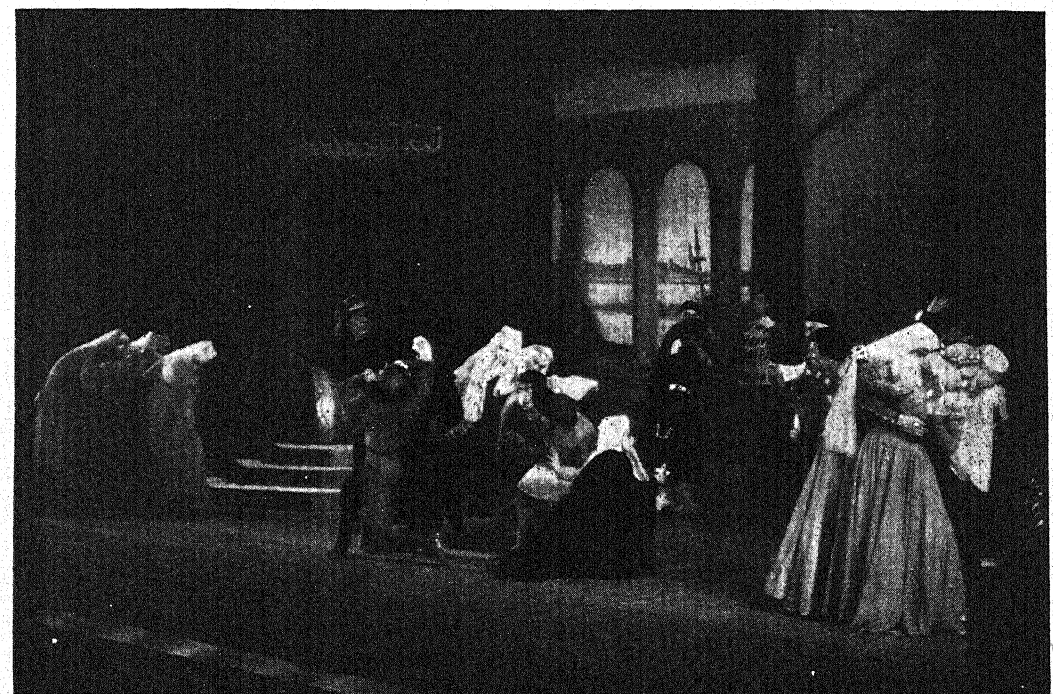
powered lenses. In many cases the photographer can determine his position to his own best advantage. The governing factor in the case of stage photography of the dance will be the quantity of light thrown on the figure or figures to be photographed, and the distance of the light source from the illuminated object, *i.e.* the dancer and also the distance of the photographer from the "lit" dancer.

Lighting and Shutter Speeds. It must always be borne in mind how much light is absorbed by a dark auditorium before it reaches the camera. On the density of the photographic image will, after all, depend whether a technically satisfactory result can be obtained.

Another consideration that is interwoven with the problem of lighting is the problem of shutter speed. As in the case of a dance picture in the studio the speed and type of movement will determine for the photographer the setting of the shutter. The lighting may be so powerful as to enable sufficiently fast shutter speeds for very rapid movement. That would, of course, be the ideal condition for the photographer.

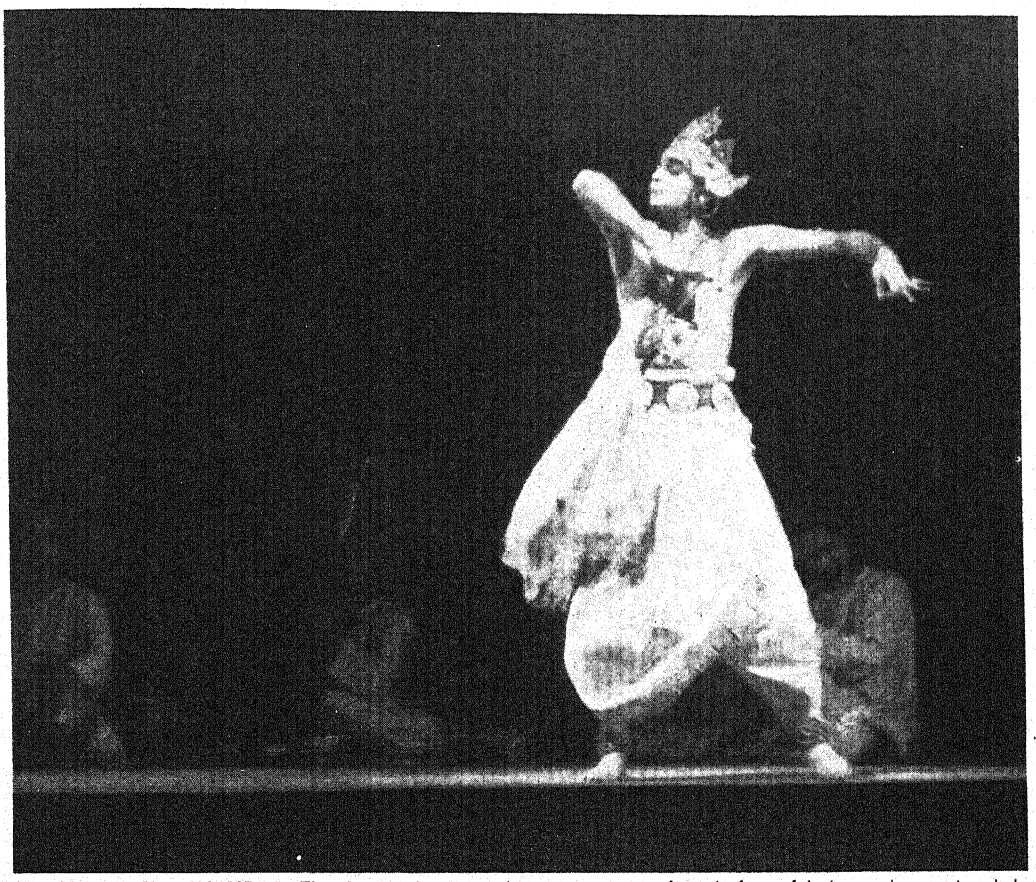
But when the control of lighting is not possible the choice of securing pictures of fast-moving action with very little backcloth and less important groups of dancers showing, or a well-exposed negative of slower movement and complete shadow detail, will be imposed on the photographer. The outstanding importance of one problem may determine the abandonment of solving another. In very fast-moving dances there will, at times, be no other possibility of obtaining a usable photograph. The shorter exposure given at a requisite fast shutter speed will give less shadow detail but will retain essential and characteristic fast movement in the photographic result.

Different forms of dance in themselves must very largely influence both aesthetic and technical problems. Ballet, and what we call Central European for lack of an adequate name for a more recent and very dynamic manifestation of Terpsichore, Oriental dance in many forms, and not to forget revue, music-hall and acrobatics—all these vary greatly in aim and representation. Careful observation and study alone will lead to successful work.



A COVENT GARDEN SHOT. Only by skilful use of the camera and keen observances is it possible to obtain a photograph of a ballet scene such as that depicted here of Lichine's "Francesca da Rimini." Apart from the comparatively poor illumination, the numerous groups of figures, all in action, present difficulties that are not easily overcome

Photo, Peggy Delius, A.R.P.S.; Xenon lens; 1/100 sec. at f1.5; developed in D.76



UDAY SHANKAR IN INDRA. This photograph, taken with a miniature camera from the front of the house, shows an interlude in a dance program at the Savoy Theatre and was taken with stage lighting. The high-lights on the figure of the dancer contrasting with the figures in heavy shadow in the background provide a dramatic effect that adds to the general interest of the picture

Photo, Peggy Delius, A.R.P.S.; Hektor f1.9 lens, Kodak Super X film, Meritol developer

The main problems of speed and illumination determine the tools and the technical process to be adopted. A rapid lens with adequate depth of focus mounted on a camera equipped with easily variable shutter speeds and a coupled focussing device are absolutely essential.

In the writer's experience the miniature camera has clearly established superiority over every other camera type used for dance photography. A high aperture lens on a large camera will rarely give a depth of focus worth considering for such purposes. No other camera type is equipped with a precision range-finding device coupled to the lens mount and, therefore, enabling high speed work under every condition.

Processing. Recently several new fine-grain developers have been put on the market and a number of formulae have been published which have considerably influenced and improved the technical quality of action photographs. The fast panchromatic emulsions required for this type of work still have a tendency to graininess. Some fine-grain developers demand so little or no increase of exposure to make it well worth while employing them even in cases of " borderline exposures." A slightly prolonged development time may adjust any lack of shadow detail and give a technically much more pleasing result (*see* Developing : (7) Miniature Films, *and* Developing : (8) Fine Grain for Miniature Films).

For a long time dance photography has in practice, with few exceptions, been nothing more than a series of successful experiments. Growing experience and improvements of technical aids have combined to make it a most satisfactory branch of photography and a field of adventure and discovery for the action photographer.

D. & P. WORK: (1) BEST GENERAL METHODS

H. Norman Blinkhorn, A.R.P.S.
President, Professional Photographers' Association

The industry of developing and printing amateur films, known to the trade as D.&P. Work, occupies many people during the holiday season. An understanding of the processes, as described in this article, will enable anyone desiring to undertake it as a small business to make a start, and will also teach the amateur what to expect from his exposed films

"PLEASE develop and print one of each!" These words are repeated many thousands of times throughout what is termed the D. & P. season, or, in other words, that part of the English summer when myriads of cameras come out like the midges. There are many customers who have not the remotest idea what happens to their films from the time they leave their hands until they call for their completed order. On the other hand, there are today numbers of enthusiastic amateur photographers who can not only discriminate between good and bad work, but who can give a very good idea of the cause of the bad work.

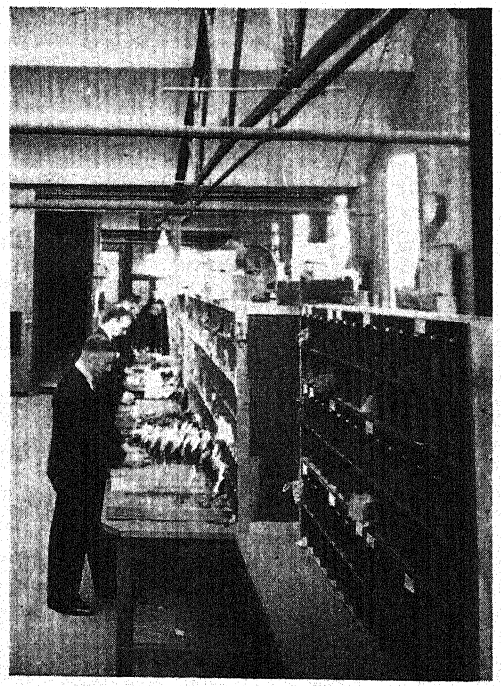
That there is a good deal of poor quality developing and printing done even today is certain, and yet there is no excuse for poor quality D. & P. Quality need not be sacrificed to speed. We live in a machine age, and there exist in this country today many firms doing D. & P. who are fully alive to this. Their works are equipped with apparatus capable of handling with every care and attention thousands of spools per hour.

Classification. Generally speaking, D. & P. work can be divided into three classes, *viz.*

(1) Large trade workers with fully-equipped premises to handle vast quantities of work sent daily from dealers.

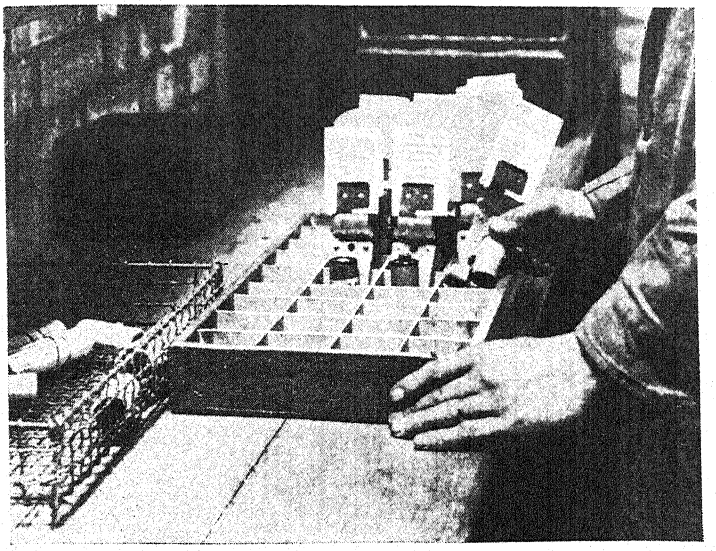
(2) Dealers with their own D. & P. department well equipped and staffed and capable of handling a reasonable amount of work received over their own counter, and, what is more important, these dealers often give a lot of this work personal supervision.

(3) Lastly, there are those who undertake D. & P. work purely as a seasonal side-line, use improvised tanks and home-made printing machines and enlargers, buy inferior chemicals and paper, and get the errand boy to do the work! The least said about the last class the better, but possibly even if they examined the profits made from this class of work they would find it would pay them far better to send their orders to some reputable firm. They would certainly do less harm to amateur photography.



FILM RECEPTION. Receiving department at a London D. & P. works. At peak periods up to 11,000 rolls are dealt with per day
Photo, The Roll Film Co., Ltd.

Procedure. Let us go behind the scenes of any typical developing and printing works and see what happens. Firstly, when the spools come in they are carefully checked and sorted into (1) sizes. (2) those requiring special treatment such as panchromatic and miniature films. This operation is done in a lighted room and every modern method employed to ensure perfect clerical control. The spools now pass to the unspooling room, which is, of course, in a photographic sense, a dark-room.



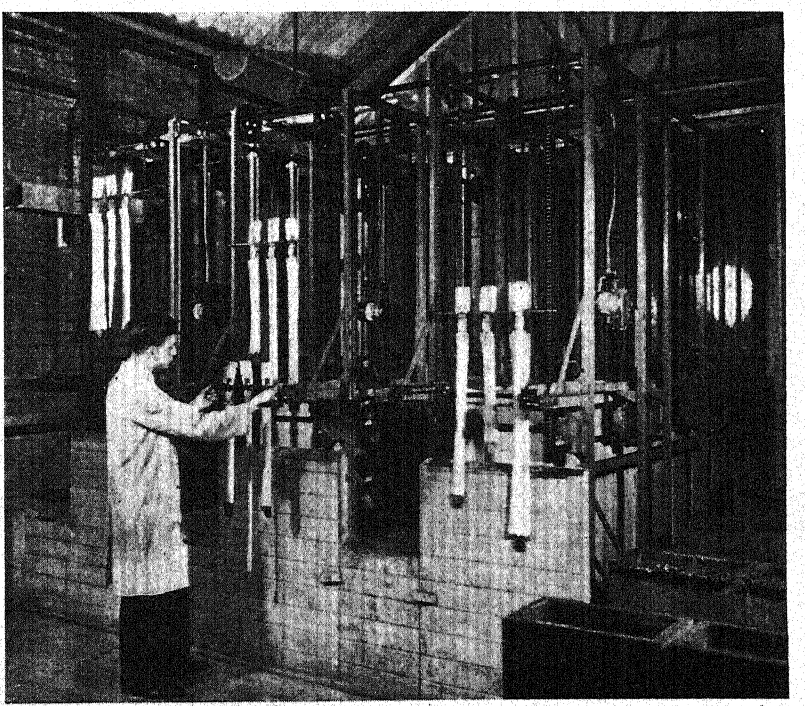
FIRST OPERATION. Spools being prepared for the dark-room. Double clips are used and the order form is attached. It remains with the film during the whole time it is in the works

Photo, London Pharmacists' D. & P. Service, Ltd.

These rooms are by no means as dim and dismal as used to be the case years ago. Modern methods of dark-room illumination ensure both speed and safety in handling. Although some firms use special unspooling devices, this is one of the processes that can be done as speedily by hand. Gloves are provided and every care is taken to eliminate abrasion. Panchromatic material is becoming so widely used that many works are now equipped with special rooms for handling this. On the other hand, efficient dual lighting is installed in smaller works and panchromatic material is handled at special times.

System. To the uninitiated it should be explained at the outset that the film has the working instructions with it, generally throughout the whole of its treatment, and it is seldom that films go astray. Many works use what is known as "The Double Clip System" to ensure this. This means that the top clip that the film is placed in for development bears another clip to carry the instructions, or order slip, which is held above the solution during all processes.

In the case of duplicate spools of the same order a special "Link System" is used. This consists of a number of small numbered and coloured celluloid tabs to correspond with the tab in the original clip bearing the order sheet. The colours of these tabs are ingeniously chosen so that in the red illumination of the dark-room they all look distinctly different.

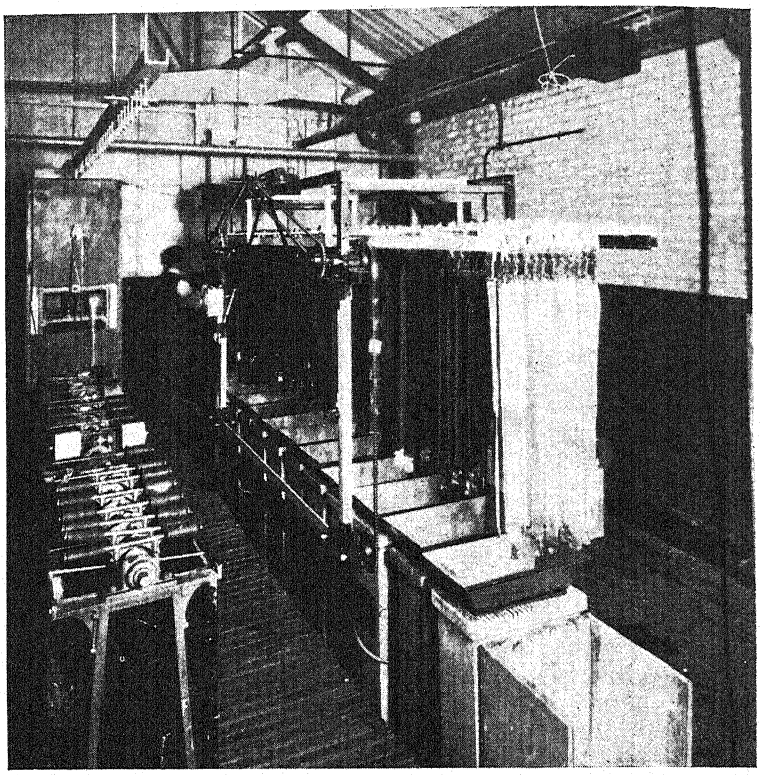


DARK-ROOM PLANT. The films are arranged on rods in the dark-room and then located on moving endless chains which convey them through the various solutions contained in tanks

Photo, London Pharmacists' D. & P. Service, Ltd.

Other methods of numbering are employed, such as punching the numbers on to the end of the film or printing it by a special machine, but, of course, this method necessitates the film being sorted back to its original order before printing.

Development. When the strips of film are all unspooled and clips attached, they are ready for development or "tanking," and, as in the larger works, the spooling is done in a separate room, this room is linked by a light trap through which the clipped films are passed on rods to the developing-room, which is also a dark-room in the photographic sense.



MASS DEVELOPMENT. A view of a negative developing machine that is designed to handle 720 rolls of film per hour. Note the overhead gear with which the films are lowered into and raised from the tanks. Lighting is by panchromatic 60-watt lamps

Photo, Roll Film Co., Ltd.

Developing procedure varies somewhat with the size of the works. A number of large establishments have completely automatic machinery. Whilst somewhat costly to install, the efficiency of these ingenious electrically controlled tanks is undisputed so far as speed and clean handling are concerned. To describe one of these systems in detail is beyond the scope of this article, but it suffices to say that after the films are attached to the rods feeding the tanks they are automatically lowered into the developing tank, the temperature of which is electrically controlled, as is the time during which the films remain immersed. When this time is up a motor is set in motion which raises the films out of the developer, conveys them to a rinsing tank, after which they pass to the first fixing tank, from that to a second fixing tank, and from this they emerge through a light-trapped tunnel into the room containing the washing tanks. In the more elaborate works the mechanical process still continues, as after washing the films travel on the same conveyers into a drying tunnel, from the end of which they arrive perfectly dried and set by hot air quite free from dust. The risk of any damage to the films is very small in these automatic tanks, provided, of course, no mechanical breakdown occurs. This very seldom happens, but it is a good plan to have some standby hand-operated plant available.

Tanks. Many large works and most of the smaller works use relays of the recognized vertical tanks, and provided due thought is given to the layout of these, large quantities of work can be handled almost as speedily, and quite as safely, as by the foregoing automatic method. Vertical glazed earthenware tanks are used holding up to 48 gallons of solution. The larger capacity tanks are much more economical both from a time and from a material basis, and in every department of a D. & P. works time is the essential factor.

The most suitable arrangement for the tanking rooms when this type of tank is

used is for the floor to be of concrete with a fine finish, which should slope slightly towards a trough about 3 inches deep and of sufficient length and width to hold the number of tanks required. The tanks themselves are raised on blocks of wood to keep them clear of the bottom of the trough, and running along the entire sides of the tanks is a platform about 18 inches high to facilitate the easy withdrawal of the films from one tank to another.

The tanks are usually arranged in one long line in the following order : Developer, Rinse, 1st Fixing, 2nd Fixing, 1st Washing, Final Washing. These tanks should be so arranged that space is left all round for easy cleaning both inside and out.

As temperature plays a most important part in the development of films, the tanks used for this purpose are permanently fitted with electric immersion heaters efficiently earthed. Of course, all film development is done by the " Time and Temperature " method, and in all busy works an alarm is set to give warning when the batch of films has been long enough in the developing tank. As peak periods in many works occur during a spell of hot weather, much attention is now being given to methods of maintaining even temperatures throughout, and though somewhat costly, air-conditioning plants are being installed to ensure this as over-heated solutions are often the cause of serious trouble.

Film Drying. Correct film drying is most important, and there is a plentiful supply of suitable apparatus available for this, though many works prefer to construct their own drying tunnels through which the films travel slowly. Any type of drying apparatus must be installed where the air is free from dust. An efficient but cheap form of ensuring this is for all doors and windows connected with the department to be hung with moist muslin curtains.

Printing. The developed films are now ready for printing. In general practice the strips of film are not cut up into separate negatives before being printed, as all modern apparatus is constructed to take the strip films. As the films generally arrive in the printing rooms in sorted sizes, time is saved by the necessity of making frequent changes or adjustments to the printing machines.

There are many types of ingenious time-saving printing machines available, including the very latest " photo-electric cell " type. A description of these machines would take up considerable space, but the way they are usually laid out is worthy of notice.

Of course, amateur contact prints are usually made on what is known as " gaslight " printing paper, which is made in various grades and finishes, to suit the particular negatives and customers' requirements. As this paper can be handled in an orange or pale green light, there is no necessity for the printing rooms to be badly illuminated, as is so often the case.

To return to the layout of these rooms, " speed " is again the keynote and every possible point is carefully studied to ensure this. Printing machines are often arranged on a platform above the developing trays where the image on the exposed print is brought out. The raising of the printing



PRINT DISTRIBUTOR. The machine shown here enables prints to enter the developer separately and at regular intervals. Each print is developed in a revolving dish, which allows for individual attention

The London Pharmacists' D. & P. Service, Ltd.

machine serves a dual purpose : it keeps the " wet " and the " dry " sides of the room isolated, and as the operator makes the prints these can pass down a slide almost into the hands of the person doing the developing of these prints.

Many ingenious arrangements of the trays or dishes containing the developer have been devised. Possibly the circular system is one of the best. In this method the trays are arranged in large circular troughs, two printing machines feeding one sink or trough, the prints arriving at one side for development and being passed to another person for rinsing and first and second fixing. This keeps any fixing solution away from the developing baths and obviates one operator getting developer and fixing solution splashed from one bath to another.

Even in development the prints are rarely touched by hand, as operators are most efficient and adept at handling prints with various types of " paddles " provided. Developing dishes or baths are all kept at even temperature, generally by electricity, and fresh developer and fixing solutions are available at the touch of a tap, so that as the baths need replenishing or renewing no time is wasted.

Print Washing. Washing is the next stage, and as the permanency of the prints depends on this a great deal of attention has to be paid to various systems of washing prints quickly and yet to ensure the elimination of all hypo. Naturally, as the prints are now fixed, washing operations can be done in a normally lighted room, and so generally they are sent in trays of water through light traps into the special washing and drying departments. What is known as Cascade washing is probably as popular as any because it takes up a minimum of space, is economical as far as water is concerned, and thoroughly efficient.

Print Drying. The prints are now ready for drying, either as glazed or in any other finish as ordered. As about 98 per cent. of amateur prints are required glossy, great attention has been paid by the manufacturers to produce emulsions that are hardy enough to stand glazing on the electrically heated and operated chromium drums without any special hardening baths being used. In extremely hot weather it is better that the prints should be hardened to avoid any possibility of sticking, blistering, or frilling.

Trimming. The prints feed themselves into trays as they come off the glazing drums and the trays of prints are now passed to the trimmers. Many types of trimmers are used. On the Continent one finds the deckle edge is almost exclusively used, but it has never gained much popularity in Great Britain.

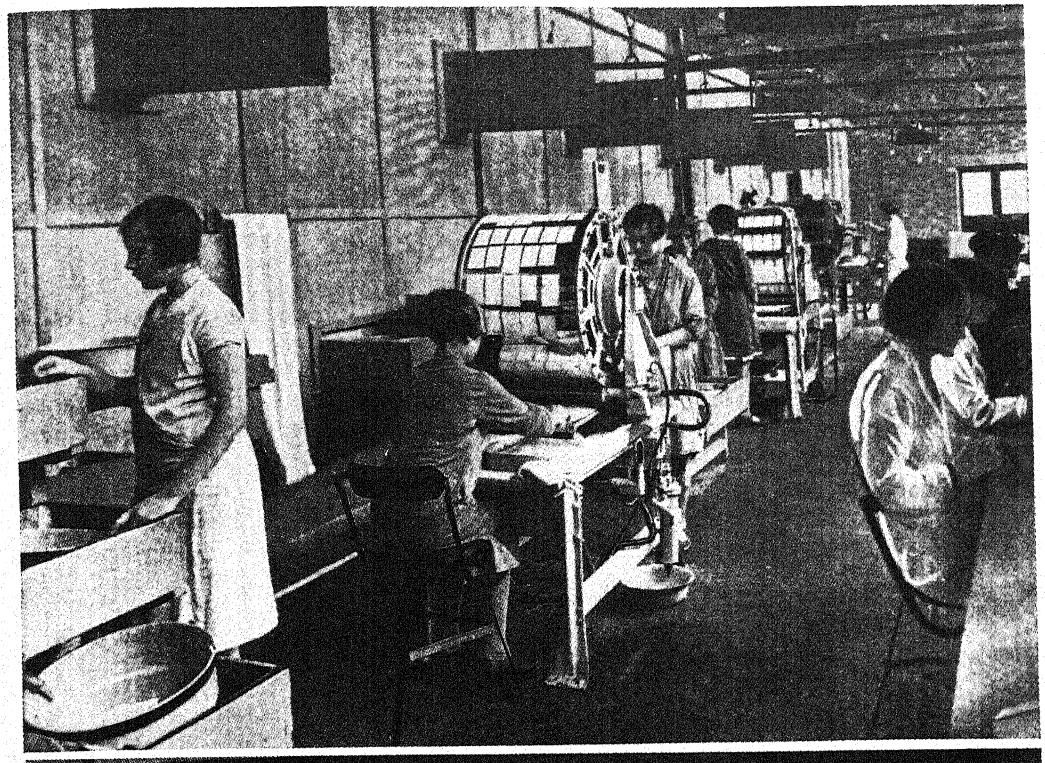
To watch a number of girls trimming thousands of prints is a fascinating sight, and their fingers and eyes are so trained that perfect margins and straight edges are obtained, often without resource to the special devices fitted to the trimmers to ensure this.

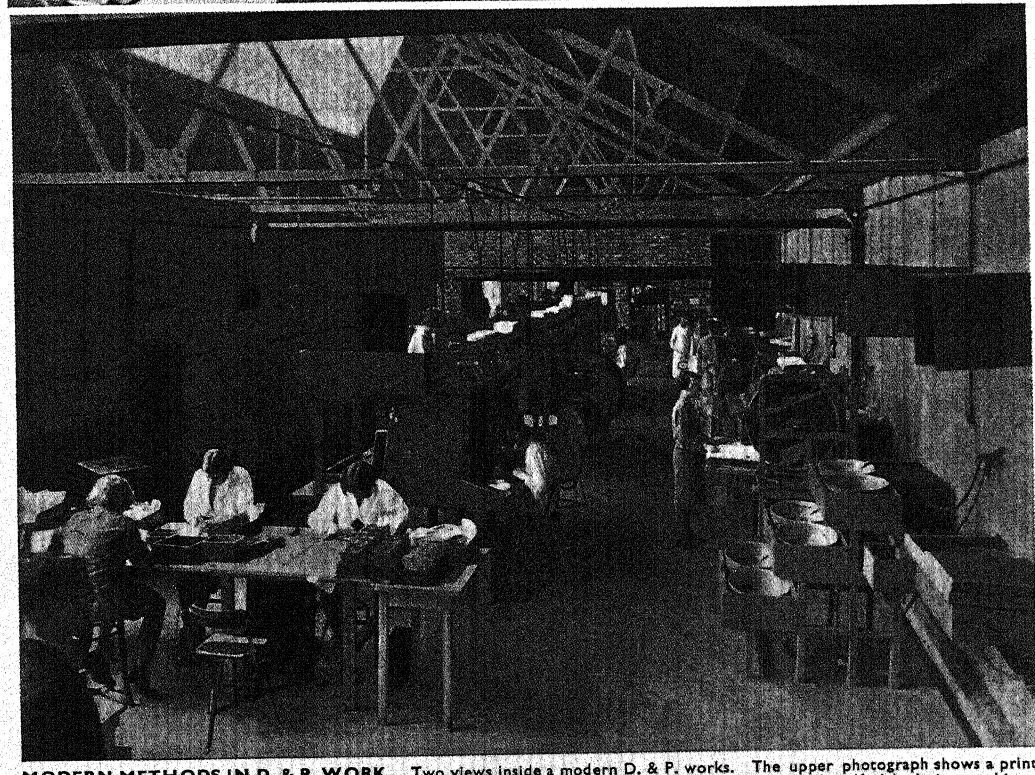
Sorting. The prints are now sorted into their respective orders, and here they usually join once more the original films which are now cut up ready for " walletting." At this stage, too, the prints are carefully checked, and it will be found on the back of each print that a number has been printed at the same time that the paper was exposed. These numbers correspond with the original works order number, and thus are identified.

At this stage, too, each print is carefully examined and any not up to standard are matched to the original negative which is sent for reprinting. Although seldom necessary in a perfectly run works free from dust, some works make a practice of " spotting " all prints that require such treatment. This means that small defects are removed. It is these little extra services that though costing very little make all the difference between good and bad workmanship.

The prints having been in their respective wallets pass to the clerical and despatch department, where orders are again checked with the lists sent by the dealers, each item is priced and the work is ready for dispatch.

Enlarging. Enlarging and special size work, of course, is done in rooms set apart for the purpose. The same applies to " EnPrints," which is the name adopted for standard size prints from miniature negatives. Up till quite recently this type of print has had to be made on bromide paper, which has to be handled in a different type of light from gaslight paper. Recent apparatus and printing papers, however, have made it possible for these EnPrints to be





MODERN METHODS IN D. & P. WORK. Two views inside a modern D. & P. works. The upper photograph shows a print washing and glazing department where the prints are immersed in rocker washers and afterwards glazed on Kodak glazing machines, seen in the centre of the picture. In the lower photograph operatives are seen at work at the assembling and pricing tables. Note the conveyors coming from the adjoining printing room

Photos, The Pharmacists' D. & P. Service, Ltd.

made on gaslight paper, and so in some cases machines making larger prints than the original negatives can be linked in with standard printing machines.

The rapid development of the miniature camera with the necessary special treatment of the films used by these cameras is causing drastic changes in many up-to-date works. The problems of fine-grain development are being seriously tackled and special equipment installed to deal with this. Owing to the extra cost in time and material for the treatment of miniature films, it is apparent that, provided they do get this special treatment, the charges to the customer must be considerably higher than for standard work. The miniature camera user seldom objects to this, as the difference in quality more than recompenses him for the extra charge. Most miniature users are fully alive to poor quality work and thus those firms who are sacrificing quality to do miniature work at cut rates will find they will not get their full share of this rapidly growing branch of amateur photography.

This article has been an attempt to show that by careful planning of the works, careful arrangement of all apparatus, and the most careful study of minute details that make for labour saving, a developing and printing works of any size can be so run that quality need not be sacrificed to speed.

The illustrations which accompany this article will explain a number of the arrangements and some of the apparatus described, and they have been chosen from a representative number of works and makers of apparatus.

No attempt has been made to describe any particular works, but rather to give an idea of what is the general procedure in most of the modern developing and printing works.

D. & P. WORK: (2) KODAK METHODS

A. W. Richardson

Of Kodak, Ltd.

In the following article the organization which ensures business efficiency in the handling of D. & P. work, and the exact technical processes through which each film must pass from the time it leaves the hands of the customer until it is returned to him are described. As photo-finishers on the largest scale themselves, Kodak, Ltd., offer high standards of apparatus and method to the trade

In the early days of photography, amateurs carried through the whole photographic process themselves, from exposing the negative to making the print. With the coming of roll-film, which made possible snapshotting as we know it today, photography ceased to be the preserve of a limited number of skilled workers, and became a universally popular hobby. Parallel with this growth came the demand for a developing and printing service, until at the present time the great majority of photographs made are developed and printed in a photo-finishing works.

Photo-finishing works vary very greatly in size from small undertakings run by individual dealers to works of very considerable magnitude who do the developing and printing for a large number of dealers.

In spite of this diversity, however, it should be remembered that progressive manufacturers of photographic materials, realizing the importance of good developing and printing to the welfare of the photographic industry, have made a special study of the requirements of photo-finishers; the result is that all over the country photo-finishing works are run on lines which have been developed in the laboratories and works of such manufacturers.

There are two aspects of every photo-finishing business—technique and organization. Technical efficiency depends to a large extent on efficient organization. The finisher, in the nature of his business, is dealing with an immense number of small orders differing in detail and in constantly changing stages of completion, so that rigorous control is essential if a breakdown in service is to be avoided. It is probably not too much to say that the clerical routine and control of D. & P. orders is the most difficult problem which a finisher in any considerable way of business has to face.

It is necessary, therefore, to deal in some detail with the methods employed for ensuring

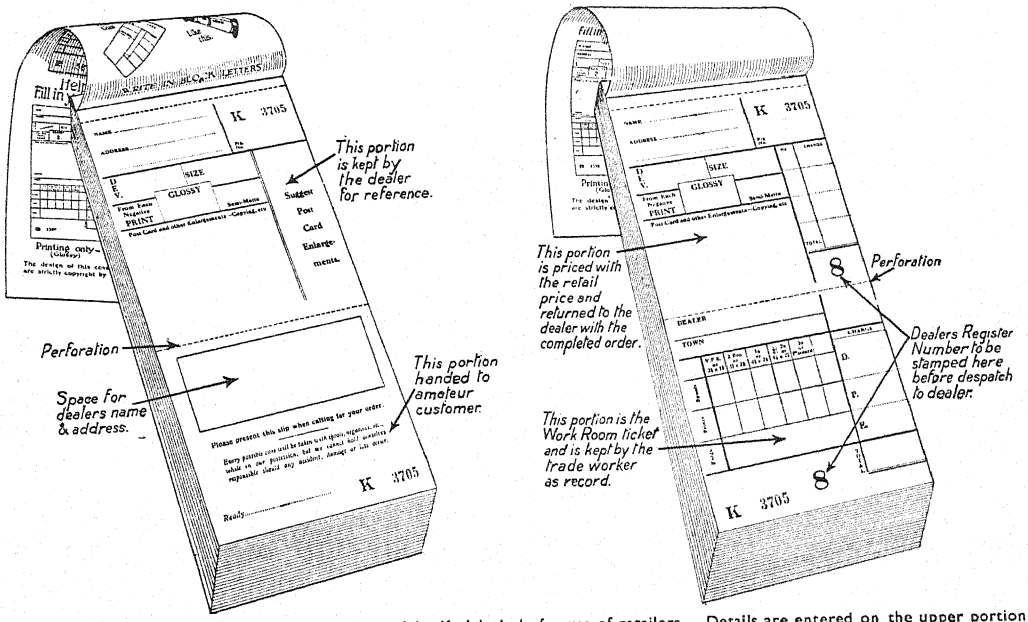


Fig. 1. Left, D. & P. counter order form, devised by Kodak, Ltd., for use of retailers. Details are entered on the upper portion of the form and the lower half is handed to the customer. Right, form for use of dealer and trade worker. Each half bears a number allocated to individual dealers. These forms, which have been evolved to contribute to speedy and efficient execution of orders, are in wide use in the photographic trade

the efficient running of a finishing undertaking. The following account, based upon the system devised by Kodak, Ltd., and generally in use throughout the country, has overcome the problems encountered.

When a film is handed to the chemist or retailer for developing and printing, the customer's requirements are entered on what is known as a D. & P. counter order form (Fig. 1). Details are entered on the top portion of the order form, which is in duplicate, and the customer is given the lower part, which is numbered and serves to identify the order when the customer returns for it. At various times of the day the finisher collects the films from the dealer, and when they reach the works they are taken to the developing room to be clipped up for processing. Negatives for reprints or enlarging are sent to departments concerned.

Each dealer is given a number, and this is stamped on the counter order pad which is supplied by the finisher. A control cabinet (Fig. 2), which is made to take a unit of 15 dealers, measures 1 ft. $1\frac{1}{4}$ in. high, 4 ft. 11 in. wide and $11\frac{1}{2}$ in. deep; this cabinet is fitted with pigeonholes to take the finished work, addressed labels and envelopes, the daily invoice pad and holder (Fig. 3). Each dealer has a section in the cabinet allocated to him according to number.

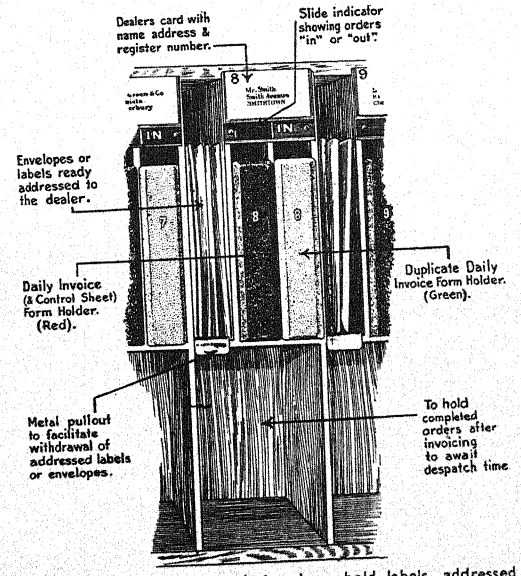


Fig. 2. Control cabinet designed to hold labels, addressed envelopes, invoice pad, holder and finished work

Some finishers prefer to "tick in" every order received, and for this purpose control sheets are available.

The procedure is as follows:

When received all of the orders are "ticked in" on

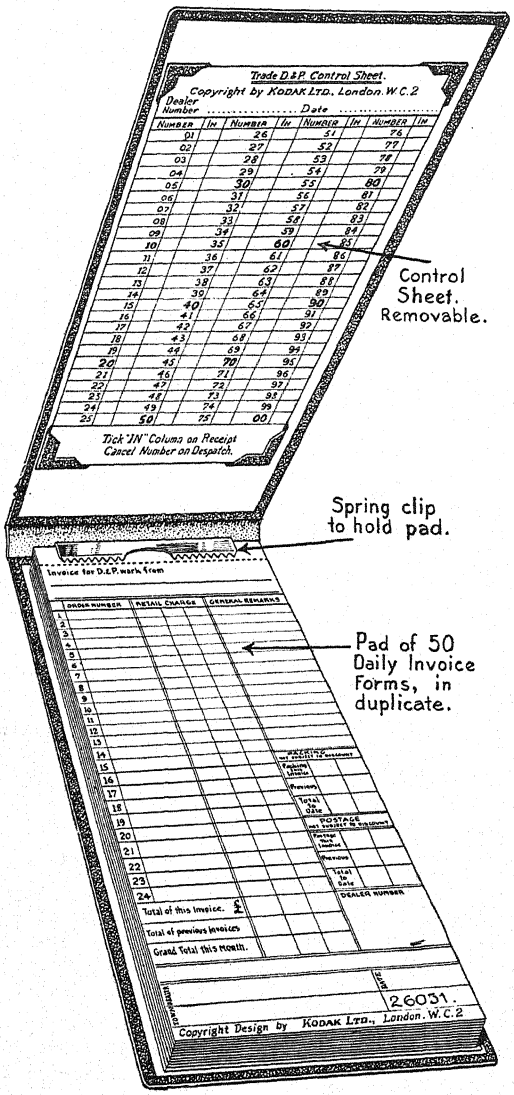


Fig. 3. Kodak trade D. & P. control sheet for use of finishers. Each order is entered on this form, and it is then sent to the various departments. When the order is completed the form (see Fig. 1) is returned to the control cabinet and is cancelled on the control sheet

the control sheet and then sent to the various departments. When finished the order is returned to the pigeonhole and is cancelled out on the control sheet. The amount is entered on the daily invoice form which is sent with the orders, a duplicate being retained in the special holder in the pigeonhole.

Developing. The first step in the finishing process is developing, which is, of course, the conversion of the exposed film into what is known as a negative. The developing outfit consists of a set of tanks of either 12, 20, 24 or 48 gallons capacity, according to the size of the finisher's business. They are laid out in a straight row, the first tank for developing, the second for rinsing, the third and fourth for fixing, and the fifth and sixth for washing. Two sets of six tanks are shown in Fig. 4.

It is, of course, of vital importance that the films shall be identified with the name of the customer to whom they belong, and this identification is provided for by the Kodak Double Clip. The order is placed in the top portion of the clip while the end of the film is inserted into the lower portion of the clip. When the film is unspooled a weighted clip is attached to the other end so that it hangs vertical, with the double film clip and order at the top. Thus the order form and the film remain together throughout the whole of the process until the time when the strip of film is actually cut up and placed in the wallet ready to be delivered to the customer.

The most convenient method of developing roll-films is to do so by batches—the size of the batch depending, of course, on the capacity of the tank. Thus, for example, a batch of 18 films is considered sufficient for a 12-gallon tank ; a batch of 30 films for a 20-gallon tank, and so on. The " time and temperature " system of developing is now usually employed, the length of time the films remain in the developer depending upon the temperature of the solution. The latest form of developer known as Kodak time standard developer is an improvement on previous formulae in that hitherto it had been necessary to judge the extent to which the developer was exhausted and to give correspondingly longer development time accordingly ; whereas with the new formula and with controlled use of replenishing solution the activity of the developer is constant throughout its life, and therefore calls for no calculation or guesswork. Thus at a temperature of 68° F. the time of development is always 8 minutes ; as many as 2,000 rolls of $3\frac{1}{4} \times 2\frac{1}{4}$ in. film can be developed in a 12-gallon tank before the developer is exhausted.

In recent years the use of 35-mm. precision cameras has increased. Since it is essential that a negative of as fine a grain as possible

shall be obtained in these small sizes most finishers maintain a special developing bath for such films, and for these special developers, such as the Kodak ultra fine-grain developer, are available.

After the films have been developed they are placed in the rinse bath for approximately one minute, and are then passed on to the two fixing baths where they remain for 10 to 15 minutes. They are then moved into the washing tanks; the time recommended here is 10 minutes in the first wash tank and 30 minutes in the second. Good washing is extremely important because unwashed portions of the silver emulsion may bleach out on the negative and spoil it.

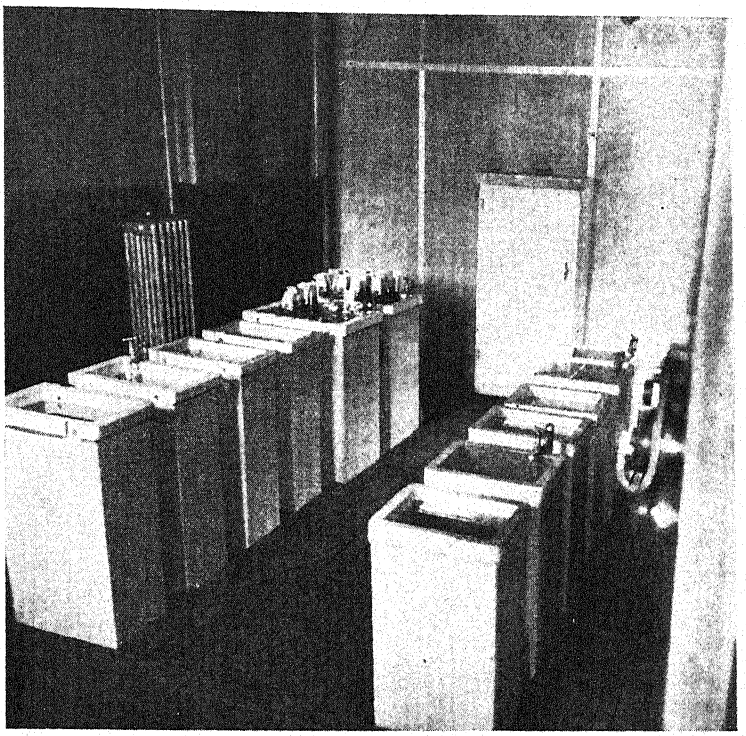


Fig. 4. Developing outfit at Kodak works, Wealdstone, Middlesex. The tanks are arranged in rows and are used in rotation for developing, rinsing, first and second fixing, and for first and final washing of films. The washing that completes the process occupies 30 minutes

Photo, Kodak, Ltd.

Drying. When the films have been completely washed they are taken to the drying cupboards. Correct drying is essential as there is otherwise a possibility that the films may cockle or become brittle. The Kodak roll-film dryer is so designed that approximately 50 films can be dried properly and completely in 30 minutes. Overheating is impossible because the flat flame gas-burners are thermostatically controlled to maintain a temperature of 100° F. A 16-inch exhaust porthole type fan is mounted at the top of the cupboard and draws in the air through the metal gratings situated on each side of it. In the case of miniature films the recommended practice is to dry the films naturally, at normal temperature, and if they are placed in a drier the use of the fan should be discontinued, as even the smallest deposit of dust settling on such film has a seriously deleterious effect.

Printing. After the films have been dried they are sorted out in their various sizes, placed in a film-strip box in batches of about eight or ten, and taken to the printing-room. In this department much depends upon the ability of the individual operatives. Speed in working together with skill in selecting the correct grade of paper for the various types of negatives, as well as the ability to judge exposure are the qualities demanded of the printing operatives.

Printing machines are available which make it possible to produce good work at a very high speed. So far as choice of paper and exposure are concerned this was until quite recently entirely a matter of judgement on the part of the operative. In 1937, however, machines such as the "Velox" automatic printer were introduced which employ the photo-electric cell for judging the density of negatives. Such a machine makes —so far as the vast majority of negatives are concerned—the choice of paper and exposure entirely automatic; judgement is only called for in the case of exceptional negatives. Very little experience is required by the operative before she can turn out

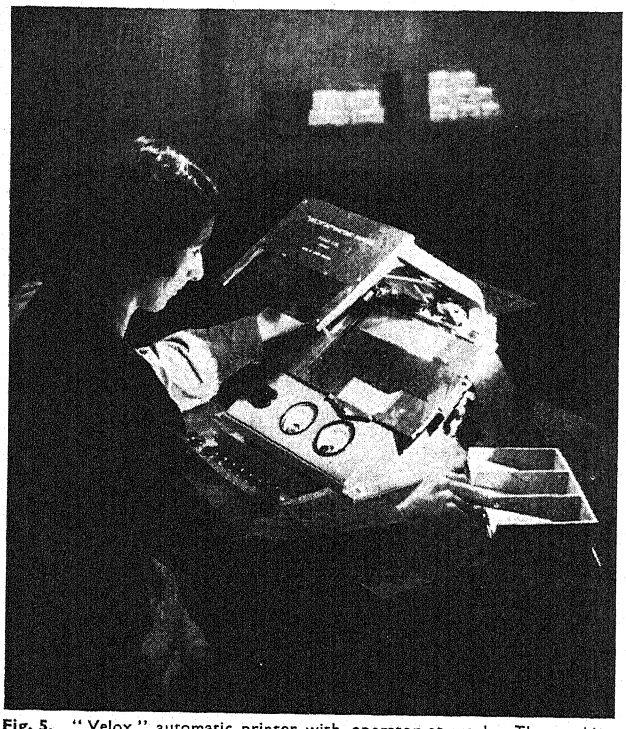


Fig. 5. "Velox" automatic printer with operator at work. The machine incorporates a photo-electric cell which controls the amount of exposure Prints of high quality are produced at great speed by this printer
Photo, Kodak, Ltd

prints of high quality at great speed with such a machine (Fig. 5).

The common practice in printing-rooms is to employ two operatives with printing machines who feed one employee working at the developing and fixing baths. Thus a single unit may be said to be made up of two girls who are occupied in printing and one additional girl who is occupied in developing and fixing. The printing operative receives the films which are brought to her in the film strip boxes mentioned above. The film is placed on the printer and the masking device adjusted according to the size of the film. The operative then makes the number of prints required and stamps the prints and the order form with a printing number. The prints are then passed to the developing girl, and after development are rapidly rinsed and passed to the fixing bath. The practice in most up-to-date D. & P. works is to employ two fixing baths, and prints are transferred from one to the other to ensure complete fixation. They should remain in each fixing bath not less than five minutes and not more than ten minutes.

After fixing the prints are washed. Thorough washing of prints is just as important as it is of film—inadequate washing may result in fading or sulphurizing of the image. Various forms of washing machines are available for the photo-finisher. For the small finisher a rotary washer, with a capacity of 200 prints up to $5\frac{1}{2} \times 3\frac{1}{4}$ in. size per hour, is sufficient. Thirty minutes wash in this form of washer is sufficient. For larger works the Kodak Rocker washer system is recommended. This system keeps the prints in their batches

Continued in page 493

Notes on the Composition of 'FAIR WEATHER'

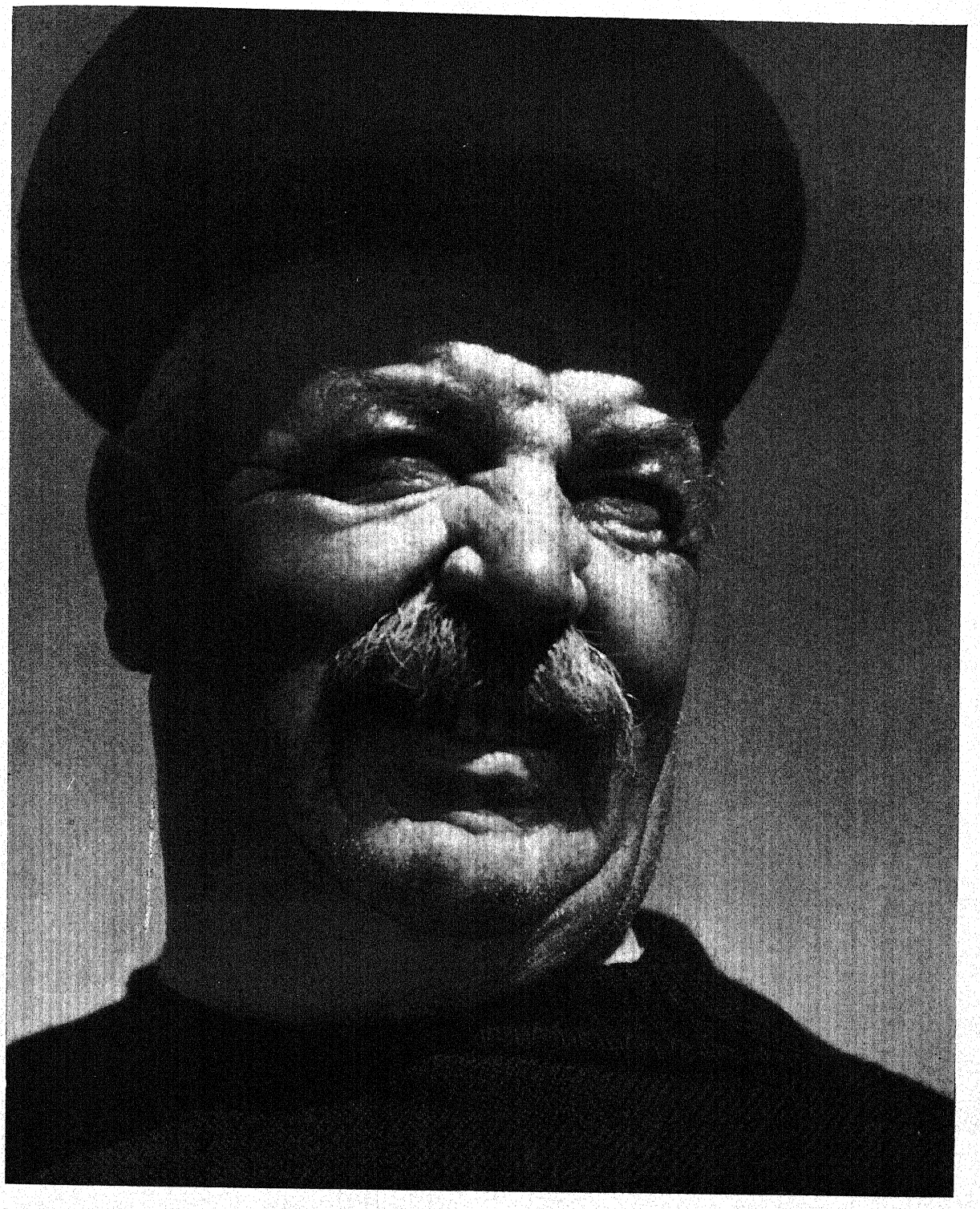
Interesting types of character are always well worth photographing, especially when presented with such strength, realism and dramatic effect as in this case. It is obviously a good "portrait," but from its very nature it has a much stronger and wider appeal than a mere likeness. It is a type.



In such a case composition is a somewhat simple matter. The head is on a large scale for the picture-space, but does not appear crowded. Much more important is the lighting and the resultant modelling. The general tonal scheme is frequently adopted for similar subjects, and is almost as old as portrait painting itself.

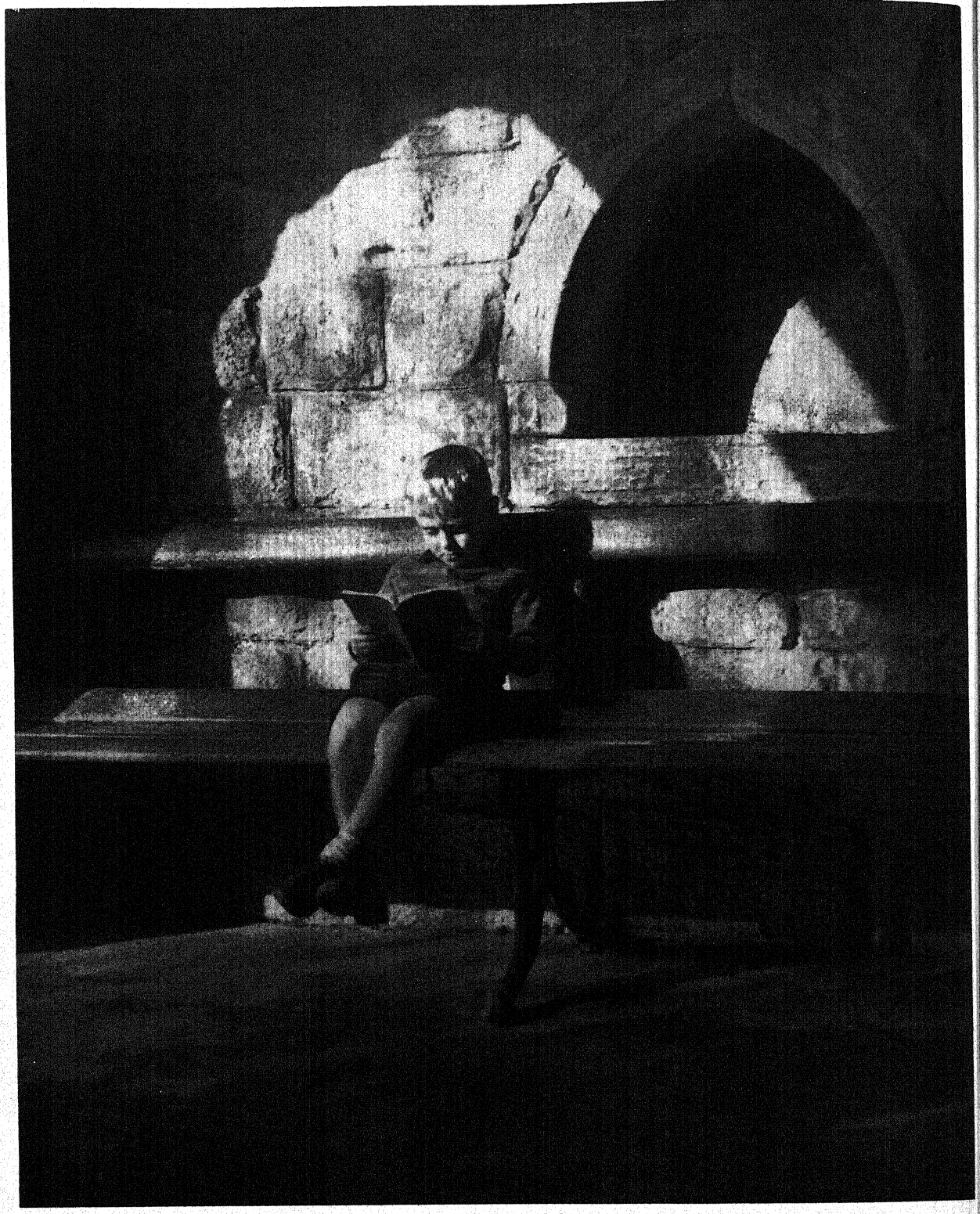
The second rough sketch is from an Italian painting in the National Gallery, and its artist died in 1561. In both sketches it will be seen that there are two strong dark masses (S—S) above and below the head; these are linked together by a moderate shadow mass (M); and the lighted part of the head (L) is thus framed and thrown into strong relief. In the print under notice the device has been used to excellent purpose, and the fine effect is apparent at a glance. The portraits are also strengthened by the contrast between subject and background. In the print reproduced opposite the device for linking up strong and moderate masses so well exemplified in the old master are used in the modern photograph, and similar principles may well be followed in other good portraiture.—*W. L. F. W.*





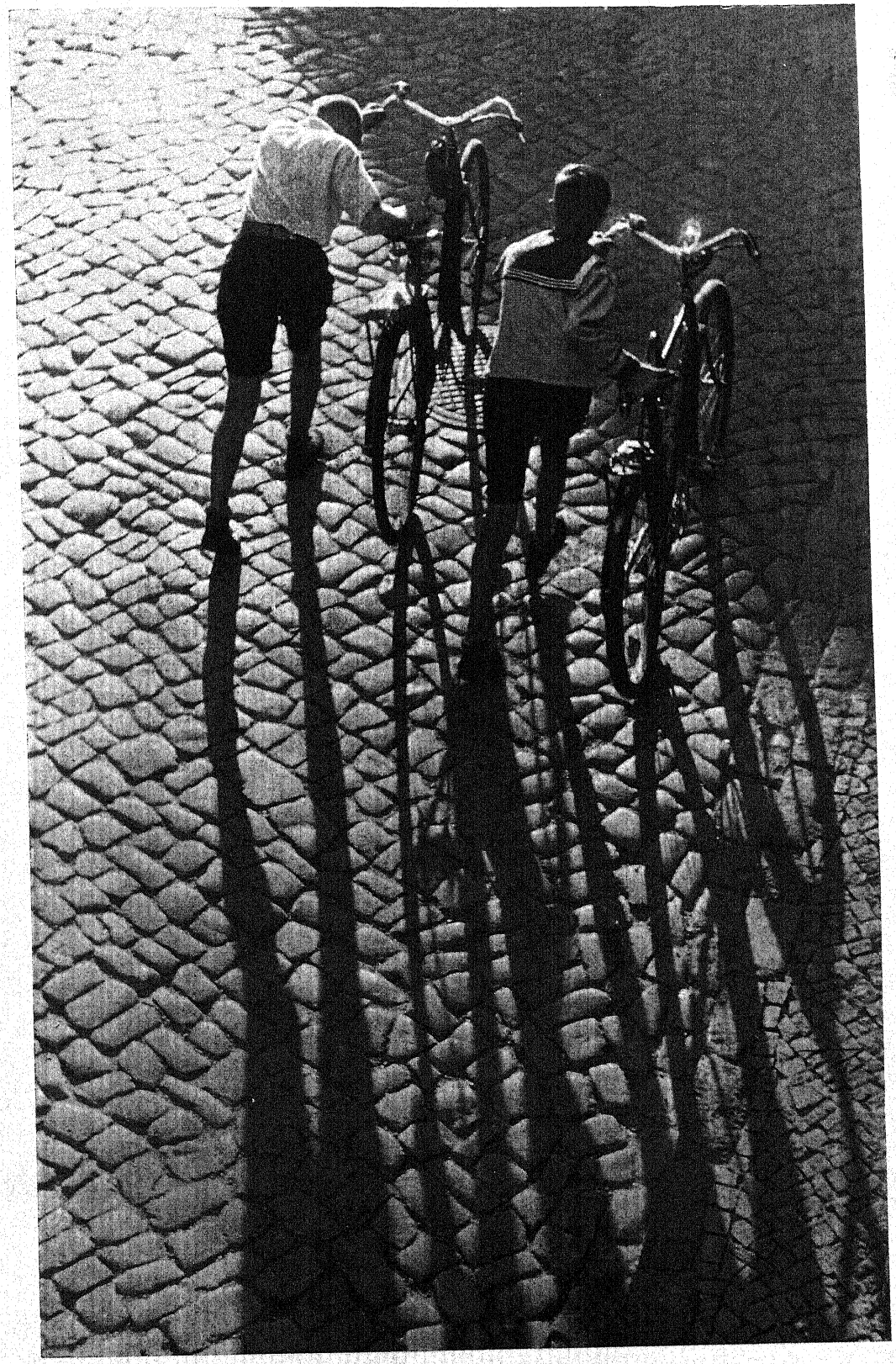
FAIR WEATHER E. Haigh

Adams Reflex camera, Zeiss Protar lens; Kodak S.S. pan. film; 1/25 sec., f11



LITTLE MAN — Mrs. N. Ashmore

From the Advanced Workers' Competition, " The Amateur Photographer " ; taken with Kodak 6-20 camera ; Kodak S.S. pan. film ; 1/25 sec., f4.5



EVENING SHADOWS H. Walther

From Zeiss Ikon Exhibition ; Contax, 1/100 sec. at f3.5





BALLET SCENES Peggy Delius, A.R.P.S.

Upper photograph of Riabouchinska at Covent Garden; 1/200 sec. at f1.5. Lower photograph of Philadelphia Ballet at London Hippodrome; taken with Leica camera; hypersensitized in mercury vapour, I.S.S. Pan. film; Summar f2 lens; Meritol developer

and ensures thorough washing with comparatively little handling.

Drying Prints. As glazed or " glossy " prints are now accepted as standard, the problem of drying is a very simple one. Efficient glazing machines are available to suit all types of finishing undertaken. In the smallest plants the use of a flat bed glazer is recommended. In larger plants rotary glazing machines are employed which dry and glaze up to 850 or 1,000 $3\frac{1}{4} \times 2\frac{1}{4}$ in. prints per hour. These glazing machines will also dry semi-matt prints if the latter are laid face downwards on the conveying cloth (Fig. 6).

The form of illumination generally used in printing rooms is that known as the " Velox " (Fig. 8). The special lamp used is suspended from the ceiling and holds a 10 × 8 in. translucent yellow safelight in the bottom portion and a transparent safelight of the same colour in the top portion. The combination of direct lighting and indirect lighting thus secured provides very comfortable working conditions. One lamp and one reflector should be fitted over each unit consisting of two operators and one developing girl.

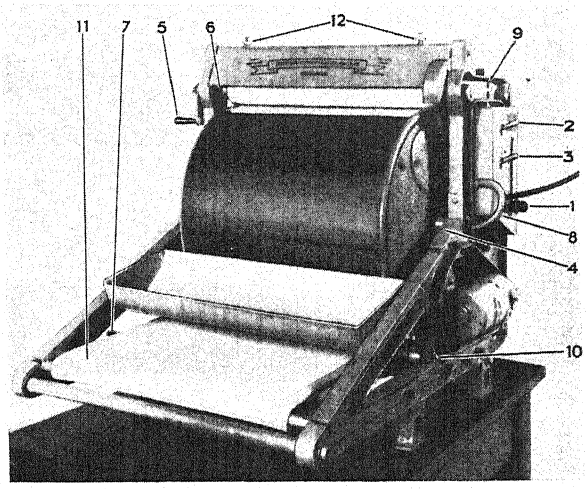


Fig. 6. " Velox " electrically-heated glazing machine capable of handling up to 1,000 prints per hour. Details shown are : (1) sliding knob on rheostat ; (2) No. 1 switch ; (3) No. 2 switch (heater) ; (4) drum bearing cover ; (5) hand lever ; (6) top roller spindle ; (7) squeegee hand lever ; (8) leads for heaters in drum ; (9) weighted tension roller ; (10) squeegee roller spindle ; (11) travelling cloth ; (12) mangle roller attachment

Photos on this page, Kodak, Ltd.

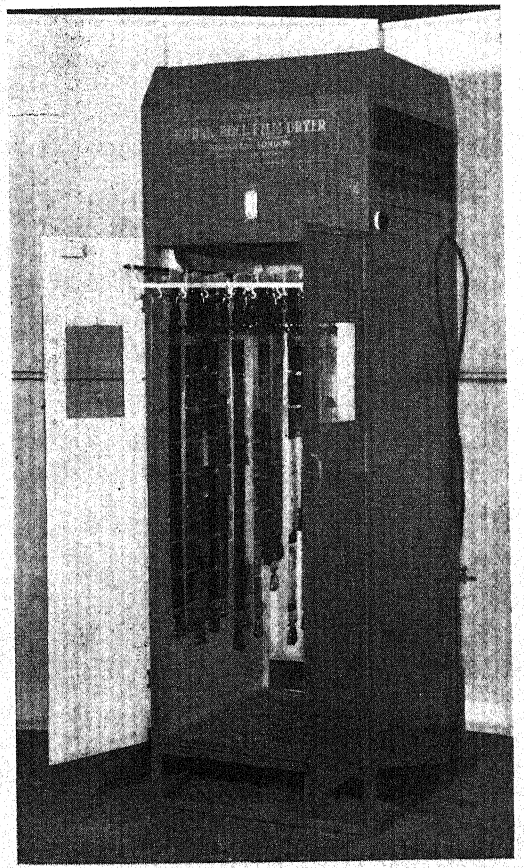


Fig. 7. Kodak roll-film dryer with which fifty films can be dried in thirty minutes. Overheating is prevented by a thermostat that controls the gas burners

Trimming, Sorting, Examination and Pricing. These operations take place in most fair-sized works along with the print finishing process, thus saving considerable time.

When the printing operative has finished her batch of film the strips of film are passed to the cutting-up and pricing bench. In some works the operative indicates on the order form the prints made, and this serves as a check on the number of prints coming through and enables pricing to be completed. The films are then placed in their wallets and the order forms stapled on it.

The wallets are then placed in a printing control rack and sent direct to the print sorting bench.

Meanwhile, the prints which have been made from the films in question have been developed, fixed, dried and glazed. At the print sorting bench they are checked for

quality and shortages, placed in their wallets if correct and then passed out for invoicing and dispatch.

The above account gives a general idea of the routine work involved in the developing and printing of roll-films. There are, of course, other departments, such as those devoted to enlarging, copying and finishing —" finishing " in this case referring to the expert work of retouching and mounting enlargements. The enlarging departments of D. & P. works are often very extensive, as there is a growing demand for this type of work. Here very considerable skill is demanded of the operatives ; they must know what type of paper to use to get the best out of the print, and how to shade negatives, as well as choose the correct contrast grade of paper and judge suitable exposure.

Perhaps we should conclude with a word of caution. Photo-finishing is a very difficult business which demands not only considerable organizing ability on the part of the management—ability which is put to a severe test at those times of the year, such as bank holidays, when business reaches sudden peaks—it also demands scrupulous cleanliness and the use of the best quality materials. Success and material profit is possible in the business of wholesale photo-finishing, for the man who has the training, organizing ability, personality and necessary capital. Success without these essentials is almost impossible. Many with capital and personality have tried and failed because of lack of knowledge of technical and organizing requirements. If the reader is tempted to enter the business he will be wise to consider training as the first essential. He will learn during this training whether he possesses the necessary personality and organizing ability to enable him to achieve success.



Fig. 8. Printing room at the Kodak works. The operatives work in groups of three, two working the "Velox" printers, while a third handles the developing and fixing baths. The room is illuminated with " Velox " translucent yellow safelights
Photo, Kodak, Ltd.

DARK-ROOM: (1) PLANNING AND ARRANGEMENT

Bernard Alfieri, Jr.

Although developing tanks and other devices have enabled the amateur photographer to dispense with a dark-room for many operations, nevertheless for every professional and for every serious amateur worker with the camera a well-equipped room in which to carry out photographic work is a necessity. The following three articles deal with the planning and using of dark-rooms from both amateur and professional points of view

As modern photographic apparatus and materials have advanced, so has a well-planned dark-room become essential. The old-time bogy-hole, smothered in dust and inconvenience, a place of comparative darkness and red illumination, is practically useless today; but the improvement in apparatus and the additional fittings that are desirable do not necessarily demand much greater space, only more careful planning.

Naturally, the larger the space available the wider the scope, but it is a mistaken idea to assume that almost any branch of photographic processing cannot be undertaken in a really small dark-room, if forethought has been given to the general arrangements and equipment. With many amateur workers it is not so much a question as to what size to build a dark-room as a problem of what can be done in a given space, the only room, or part of a room, available; and the accompanying plans are intended to convey the maximum facilities available in rooms varying from a box-room measuring 5 × 4 ft. to a small general room 15 × 12 ft.

Obviously many workers specialize in certain branches of photography, and the miniature camera enthusiast would not require the same type of dark-room as a worker who wished to provide for contact printing and large negatives; whilst the experimentalist keen on trying out new processes and requiring a dark-room-cum-laboratory would not plan a room in a similar manner to someone who confined his work to any one recognized process or method and required perfection; but the following remarks apply to all.

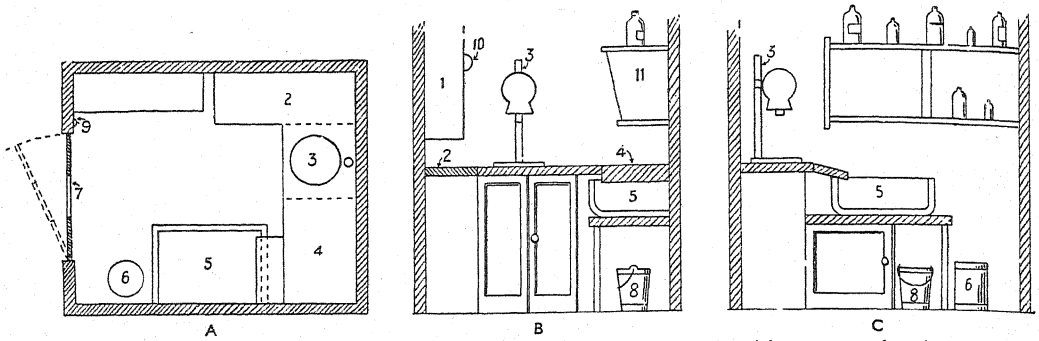
The Modern Dark-Room. An up-to-date dark-room provides for much of the work being done in daylight, or efficient artificial light; it is a room where hours can be spent in fresh air and amenable conditions, where providing light and ventilation is just as important as producing darkness, and where the work can be executed in a methodical manner with the minimum of inconvenience. It is a place where the photographer can retire for pleasure, rather than a dark hole where the uninteresting portion of the work is conducted in the shortest possible time.

Before suggesting any practical plans, it is necessary to determine what general processes will be used. Most general workers will require facilities for loading sensitive material, developing, printing, enlarging, washing and storage of apparatus and materials. Where space is very limited, most of the storage can be accomplished elsewhere, and the household bath can be used for washing. Running water may not be available, or any means of drainage, whilst the room may not be provided with a window. In other words, a large cupboard or box-room, with a maximum size of 5 × 4 ft., can be used in the following manner:

Planning the Smallest Dark-Room. First give the walls a good coat of either white distemper or, better still, flat white washable paint. Next make a few rough sketches, for a little time devoted to planning on paper will save much inconvenience later.

Fig. 1 (page 496) illustrates an arrangement that may be altered to suit particular requirements, but may be taken as a general suggestion. Our space being limited, it is to be hoped that the door opens outwards. If the photographer is not fond of carpentry, the shelves and cupboards can be adapted from ready-made kitchen cupboards and fittings.

Fig. 1A is a general plan, showing a main bench across the end of the room, on which a small vertical enlarger stands. There is provision for a sink, or wooden trough, on the right-hand side as entry is made from the door, whilst on the left-hand side of the



DARK-ROOM. **Fig. 1.** Plan and elevations showing small dark-room layout. The numbered features are referred to in this page

room is a storage cupboard for bromide paper, negatives, etc. The space under the bench and sink is fitted with cupboard doors, and a bucket for drainage is provided under the sink.

Sequence of Operations. The sequence of operations should follow from left to right as far as possible. Great inconvenience is felt if wet prints from the developer have to be passed over dry material to reach the wash or hypo, whilst if prints that have been fixed are taken out of the hypo and are passed across the developer to the washing water, disaster may follow. On commencing work such obvious points as where to put the packet of bromide paper when printing other than over the dish of hypo must be worked out. Having drawn a rough plan, it is as well to imagine actual working conditions for the various operations, and see that all is possible.

Let us try this in Fig. 1. The supply of bromide paper is in the cupboard (1). Having selected the appropriate grade, the chosen packet can be placed on the bench (2) on the left-hand side of the enlarger (3). After exposing, it is developed in a dish placed on the bench (4), and rinsed and fixed in the sink (5). Waste prints and rubbish are deposited in the tub (6). Thus all operations for printing follow from left to right.

Fig. 1 B shows the end elevation of the room with a storage cupboard on the left-hand side over the bench, and the cupboard doors underneath. Dry chemicals can be kept under the bench, and on the side of the top cupboard a small safelight can be fixed to facilitate enlarging.

Fig. 1 C is a side elevation, showing the sink, with shelves above, for standing bottles of working solutions, etc., also used as a support for the main safelight. Under the sink (5) is a bucket for waste (8), which can be enclosed with a door if desired, while the tub for dry waste (6) stands just outside. In the cupboard under the sink tanks can be arranged for developing film, and in use they can be on a board over the sink.

Assuming that there is a switch near the door (9) controlling a ceiling lamp (white), we shall require a plug and socket for a small yellow lamp (10), another one for the enlarger, and a point for the main safelight (11).

Ventilation is particularly essential in a very small dark-room, for the atmosphere is not free from chemical smells, and the more fresh air the better. Where there is no window a light-trap can be fixed into the door (7), and it is particularly helpful if a small fan is available to draw out the used air.

Converting a Larger Room. When converting a small room, such as that in Fig. 2 (page 497), of size 10 × 8 ft., the window should be preserved. The main features are substantially those of the smaller room already described, but slightly modified. To begin with, the window should be covered with a hinged shutter that can be readily opened. Sliding shutters are easily made lightproof, but it is not always convenient to provide sufficient space for the slide. Hinged shutters, which can be folded back, take up less space, and if they are constructed with a wooden rebate, lined with strips of carpet felt, there is little difficulty in making them safe. The window shutters can be fitted with a light-trap, and if the window is left open plenty of fresh air should be available. Fig. 2 A shows the general plan ; B the end elevation ; and C the principal side elevation. The sink in this case has been arranged more in a central position, allowing the use

of two draining-boards, one at either side, and a special shelf under one of them accommodates tanks for film processing. In this design the central portion of the cupboard (1) is fitted for storing films and plates, and a hinged shelf provides space for loading. All the reference numbers have been retained in each drawing as far as possible, and are as follows: (1) Cupboard for storage of dry material, loading, etc. (2) Bench space for bromide paper when in use. (3) Space for vertical enlarger. (4) Developing dishes. (5) Sink. (6) Space for hypo. (7) Light-trap, either in door or window or both. (8) Bucket for waste from sink, etc. (9) Tub for dry waste. (10) Tanks for film processing. (11) Main safelight.

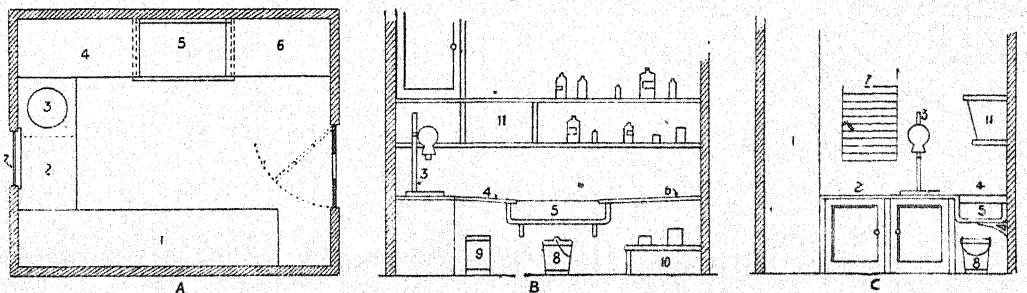
General Arrangements. The floor should be covered with linoleum, or some washable covering. If it is an upstairs room this is essential, as liquids are sometimes spilt, and patches may soak through the ceiling below. As far as possible, shelves or benches should be constructed in cupboard form to minimize the collection of dust, while some waterproof covering, which can be removed and cleaned from time to time, should be placed on shelves that will accommodate bottles of liquid.

Hypo is one of the biggest troubles, for when drops are allowed to dry on a shelf or other part of the dark-room, fine white crystals appear later and find their way to other places; and once specks get on to the sensitive material nothing short of a first-class spring-clean can insure against damage. The ribbed rubber mats sold for household purposes, when cut into strips, make an excellent covering for shelves, and American cloth can be used with advantage for bench tops, etc. Great care must be taken not to use dry chemicals for mixing developers, etc., in a position where particles can blow about and settle on any apparatus or materials; indeed, it is not wise to mix chemicals in the dark-room at all. Furthermore, there are some solutions which have a deteriorating effect on sensitive material, and if necessary to store them in the dark-room, care should be taken to select a suitable place.

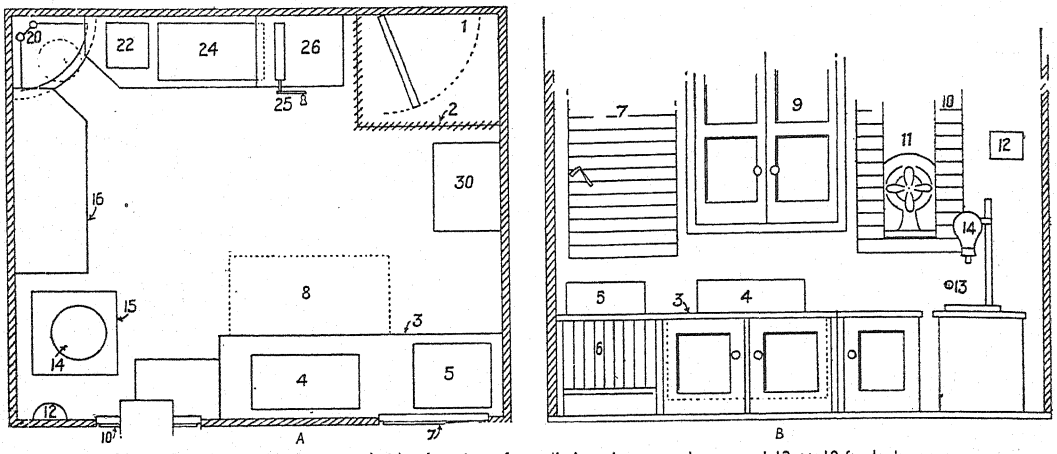
A Dark-Room for General Work. While the limitations of the smaller rooms already discussed are obvious, a wide range of work can be done in a room not exceeding 12 × 10 ft. It is little bigger, yet it covers sufficient space to enable a much more comprehensive lay-out. Assuming that the room may not always be required as a dark-room, the fittings suggested in this plan need not damage the walls, and running water can be provided from a small corner hand-basin, which will add to the convenience of the room if used for domestic purposes at a later date. The position for the hand-basin and fixtures will depend on the location of the door and windows, but the general principle can be maintained, even if modifications necessitate a rearrangement. (A fresh set of reference numbers has been used in these drawings, and must not be confused with the numbers in the previous diagrams.)

As will be seen from the plan (Fig. 3 A) the general arrangements provide for a sequence of operations in a similar way to the previous designs, but they include additional apparatus for widening the scope of the work. The door (1) is screened with a curtain (2), or can be removed altogether and replaced with the screen arrangement shown in Fig. 3 E, where the inconvenience of a curtain is replaced by that of walking round two corners.

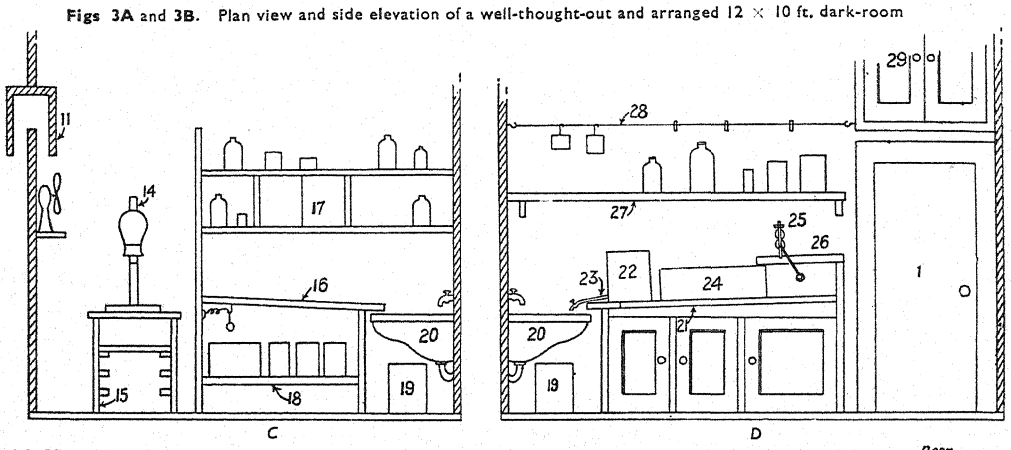
Opposite the door is a work bench (3), the details of which can be seen in the side



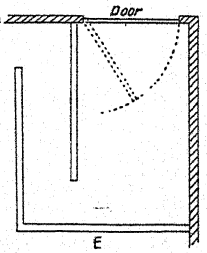
AMATEUR DARK-ROOM. **Fig. 2.** Plan and elevations of 10 x 8 ft. dark-room



Figs 3A and 3B. Plan view and side elevation of a well-thought-out and arranged 12 × 10 ft. dark-room



Figs. 3C, 3D and 3E. End elevation, side elevation and plan of door arrangement of an amateur's dark-room



elevation (Fig. 3 B), and on which there is a printing box (4) and a glazing press (5) situated immediately over a rack for holding glazing boards, or ferrotype plates.

The press is arranged in front of one of the window shutters (7), which can be opened when the former is in use.

Hinged to the edge of the bench (3) is a folding table (8), which can be used for loading, etc. The cupboard (9) is intended as a store for bromide paper, etc., while the extension of the bench (3) is a convenient place to rest packets of bromide paper when not in use. The second window shutter (10) is fitted with a light-trap and exhaust fan (11), and a safelight for use in connexion with the enlarger is shown at 12 and controlled by the switch (13).

In Fig. 3 C an end elevation is illustrated, where a vertical enlarger (14) stands on a base (15), provided with racks underneath. Then comes the first draining board, slightly tipped downwards to the hand-basin (16), on which the dishes of developer are used. Above this are two shelves carrying a double window safelight (17), one window of which can be used with a frosted glass for viewing purposes. The shelves are used for placing bottles of working solutions, distilled water, etc. Under the bench (16) is a shelf (18), carrying a set of tanks for film processing, while an immersion heater hangs in a suitable position, and the whole can be closed in with cupboard doors if required. A tub intended to contain rubbish (19) stands under the basin (20).

Continuing round the room, Fig. 3 D shows a side elevation ; the corner basin (20) receives the drainings from a second board (21), on which a tank (22) of running water is

used for negative washing ; this is connected at will to the tap over the basin, with a length of hose (23), the overflow returning to the basin and main drain. 24 is a flat trough, or sink, operating in a similar way for washing prints. A wringer with rubber rollers (25) is mounted on the edge of a small board (26), while a shelf is arranged above (27), and a line carrying wooden pegs (28). Over the door the space is utilized for a cupboard (29) which can be used for storing sensitive material not in general use.

From the diagrams it will be seen that the sequence of all operations follows from left to right, as before, with the addition of a wringer through which to pass the glazing boards, and a place to receive them. Referring back to the plan Fig. 3 A, (30) is a drying rack for glazing boards, and the sequence is complete when we return to the glazing press (5). The lighting equipment consists of a reflecting central green safelight for general panchromatic illumination, and a white light, while round the walls are plugs and sockets for the glazing press, enlarger, safelamp, double safelight, immersion heater, and a spare point into which any additional apparatus can be plugged.

Two-Room Dark-Room. The luxury of a two-room dark-room can be enjoyed where the total space is about 15 × 12 ft., or larger. Fig. 4 shows a plan for a typical room. In the first part near the door arrangements have been provided for the storage of dry materials, negatives, etc., with a good bench in front of the window for finishing and trimming, while in the second room an additional table has been provided for processing miniature films, with space for a mechanical agitator and a separate cupboard and screen in which chemicals can be mixed.—*BERNARD ALFIERI, JR.*

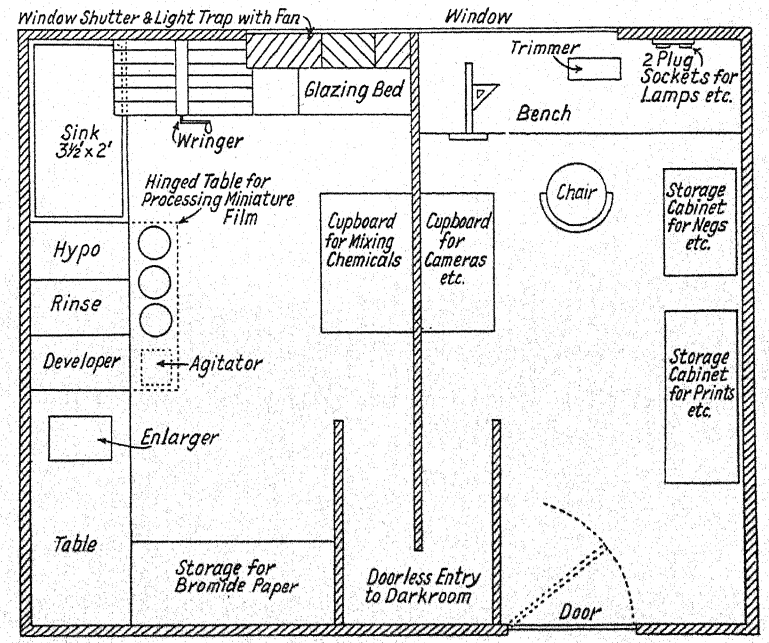
DARK-ROOM: (2) FITTINGS & EQUIPMENT

Mr. Bernard Alfieri, Jr., describes below the apparatus with which an amateur can do successful work, showing that the expensive equipment of a professional dark-room is unnecessary. Following his article is a list of material from "The Amateur Photographer"

To list the fittings and detail apparatus necessary to a well-equipped dark-room would convey the instalment of a multiplicity of accessories beyond the reasonable spending power of most amateur workers, while the function of many expensive pieces of apparatus is not only to do a given job but to do it with the greatest amount of convenience combined with speed and an ease of repetition alone invaluable to the professional.

Often the same result can be obtained from simple apparatus adapted from odds and ends, and much of the expensive equipment of the model dark-room can be substituted for simple arrangements that are quite efficient for the production of a small quantity of work.

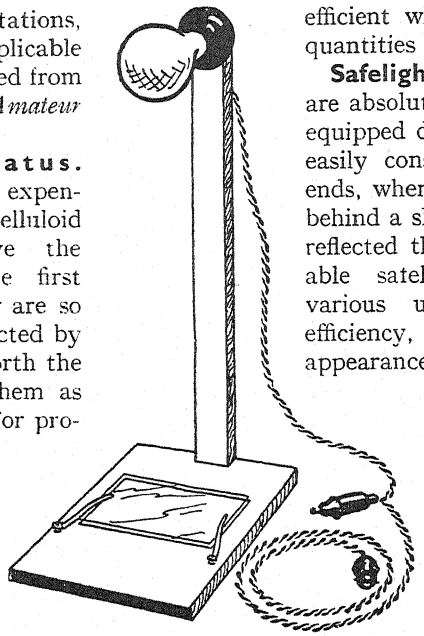
There are, however a few necessary fittings which have to be purchased, as they would be difficult to construct, such as an enlarger, developing tanks, dishes, etc., These are all dealt with separately below, after



LARGE DARK-ROOMS. **Fig. 4.** General arrangement of two-room dark-room in plan

which a number of adaptations, gadgets and ideas that are applicable to the dark-room are appended from material published in *The Amateur Photographer*.

Developing Apparatus. Although porcelain dishes are expensive when compared with celluloid or "bakelite," and have the peculiarity of breaking the first time they are dropped, they are so clean to work and so unaffected by chemicals that it is well worth the initial expense in buying them as against cheaper products. For processing miniature film, a small tank will be found to be a necessity, together with any special fittings required for the individual products being handled.



VERTICAL PRINTER. Simple device for making contact prints. The lamp is arranged 16 inches above the baseboard, on which spring clips hold a sheet of glass

Enlarger. For amateur work the old type of horizontal enlarger has been almost entirely superseded by vertical designs. Many really efficient vertical enlargers are on the market at a reasonable price, and for those who appreciate a luxury and are prepared to pay for it, a vertical enlarger of the self-focussing type will be found a great convenience.

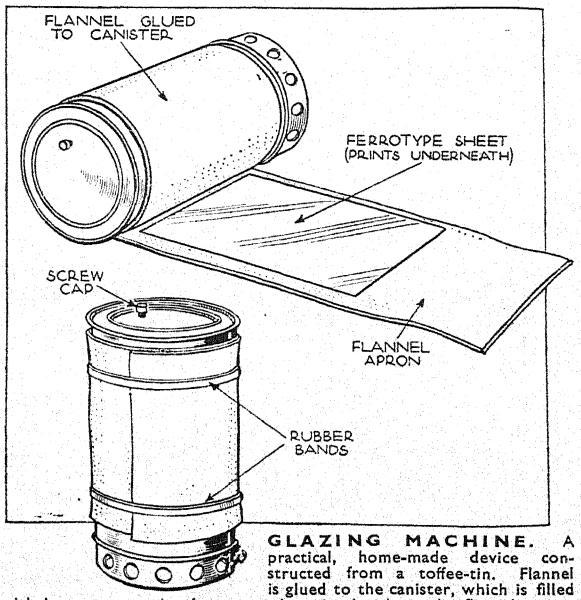
Glazing Apparatus. Ferrotype plates, or sheets with a polished surface, are required for glazing prints. Glass can be used with a maximum amount of inconvenience, and a reasonable chance that prints will stick to the sheets permanently, whilst other forms of glazing boards will require the use of a glazing solution. Chromium-plated sheets are the most expensive, but with care will last indefinitely, and because of the fact that they are both simple to use and efficient the initial cost is well spent.

Prints left to dry naturally on glazing sheets require no additional apparatus, but where they may be wanted quickly some form of glazing press, or heater, will be necessary. A flat glazing bed will be found most reasonable in price and it is very efficient when comparatively small quantities are under process.

Safelights. Efficient safelights are absolutely necessary to the well-equipped dark-room. They can be easily constructed from odds and ends, where the lamp is concealed behind a shield in a box and light reflected through any of the available safelight glasses sold for various uses; but for general efficiency, combined with good appearance, it is worth purchasing a reliable safelight together with a number of interchangeable glasses for the various operations that may be undertaken in the dark-room. A ground glass, spare, will be useful for viewing negatives.

Ideas and 'Gadgets.' These can be adapted to suit individual requirements and they can be applied to various phases of dark-room work.

A Simple Self-Rocking Shelf. To keep the liquid moving in a dish when developing or fixing, the small shelf shown in the accompanying illustration is caused



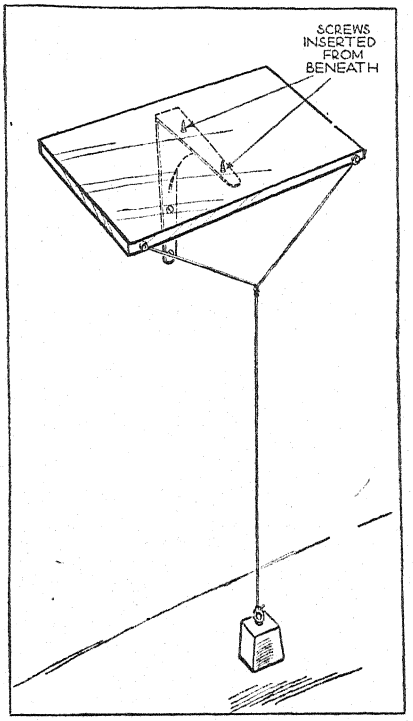
GLAZING MACHINE. A practical, home-made device constructed from a toffee-tin. Flannel is glued to the canister, which is filled with hot water, and a ferrotype sheet is placed on the flannel apron. This with the print interposed is wrapped round the tin and held in position with rubber bands

to rock on the central support by means of a heavy weight attached and suspended by a cord.—P. Rosen.

Simple Glazing Machine. For rapidly drying prints when squeegeed to glazing boards a round toffee tin about 10 inches in height and 7 inches in diameter can be filled with hot water and covered with a strip of flannel, a long end of which is left in which the glazing sheet (with prints) can be rolled round the tin for drying. The tin can be adapted for heating the water within by standing it over a suitable stove, but either the lid should be loosened or the screw cap removed to allow the steam to escape. —H. Barlow.

Storing Water in the Dark-Room. A storage bottle and simple siphon arrangement shown in the accompanying illustration is particularly useful for keeping distilled or boiled water in the dark-room. A paper clip is adapted to answer as a tap.—J. B. Higgs.

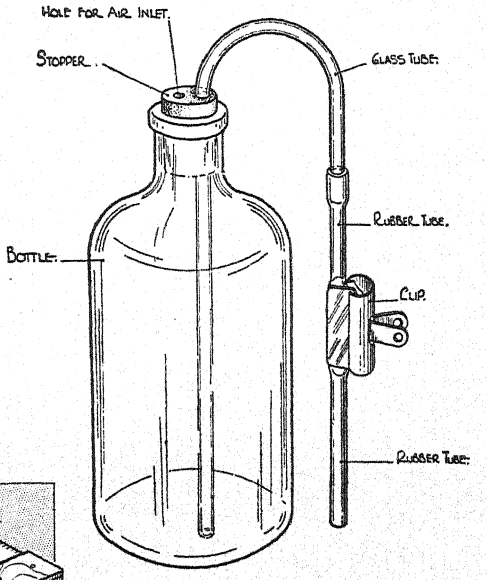
A Vertical Printer. To obtain consistent results in contact printing, with speed and ease, a device which is very simple to construct will be of great service. The base-board is made from any flat piece of wood on which an upright carries



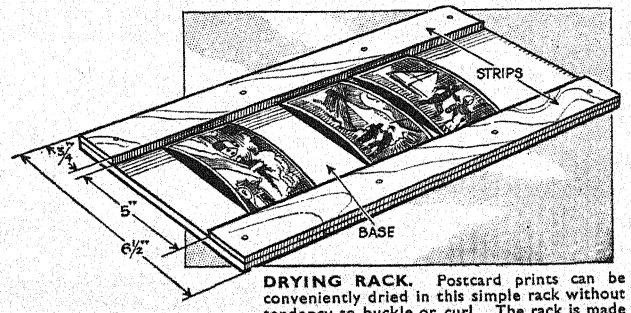
DISH ROCKER. Device used for rocking dishes during developing and fixing processes. It consists of a wooden platform to which a wire and weight are fitted. The whole oscillates on a simple bearing made from screws resting on a right-angle bracket

the lamp about 16 inches above the base. A sheet of glass is held to the printing board by spring clips. Exposure is made by means of a torpedo type switch inserted in the length of flex, which forms the connexion to the supply.—R. Gough.

Rack For Drying Postcards. A simple wooden rack, so constructed that the cards are dried in a slightly bent position. The main portion consists of a piece of wood 6½ inches wide and of any length according to the number of postcards that are to be handled. Two pieces of wood are nailed to this base, their outer edges flush with those of the base and so placed that



STORAGE BOTTLE. The inconvenience experienced in uncorking and tilting the distilled water storage bottle is obviated by means of an arrangement of U-tube, rubber tube and paper clip device which provides a siphon effect



DRYING RACK. Postcard prints can be conveniently dried in this simple rack without tendency to buckle or curl. The rack is made from three pieces of wood tacked together

their inner edges are about 5 inches apart. The method of use can be seen from the diagram on the left of this page.—G. Lawson.

DARK-ROOM: (3) FOR PROFESSIONAL WORKERS

W. G. Briggs, F.R.P.S.

Of Studio Briggs, Ltd.

The proper planning and equipment of dark-rooms for firms carrying out commercial work depends upon the procedure through which a film or plate must pass. Here Mr. Briggs, from his extended professional experience, has explained procedure with this as a basis, and describes the arrangement of apparatus in all the rooms required—film loading, developing, chemical mixing, printing and enlarging, drying and sorting rooms

IT seems a matter for some thought—and some wonder—that general practice seems to tolerate a casual attitude towards the scientific layout and planning of dark-rooms.

The majority of professional dark-rooms in this country have, like Topsy, "jest growed," and such a state of affairs should be deplored and discouraged by the sincere photographer.

Dark-room technique is admittedly a science; the dark-rooms should be laboratories where laboratory ideals are upheld.

Rarely indeed can an absolute ideal be attained—the existence of premises *in situ* nullifies such a high hope.

There are, however, broad outlines of principle in existence which should be studied thoughtfully before even a preliminary step is taken.

Let us examine the first broad principles of dark-room planning.

It should be realized that dark-room technique consists of an unvarying sequence of operations. Therefore the dark-room should be planned so that this sequence occurs in its natural order, moving from left to right.

The rooms should as far as possible be large, light, and well ventilated. The wise planner will not ignore psychological considerations—his workpeople are to spend their working days in surroundings which, owing to the nature of the work, tend to be depressing. Airy, spacious quarters will go far as an antidote.

Very important, in these times of extremely sensitive material, is the question of temperature. 60° F. may be taken as the standard, and means should be contrived whereby the amount of fluctuation shall not exceed three degrees either way whatever the season.

Cleanliness is another primary factor. The emulsioned surface of a plate or film has an affinity with dust which is quite remarkable and must be fought from the very beginning.

As to the equipment of the rooms—this should be of a type that will not only perform its appointed task with the maximum of efficiency in the minimum of time—it must also be adequate to deal with the greatest volume of work likely to be in production at any given time, even if normally it is not working at full pressure. The planner visualizes and allows for the exceptional.

Having thus enumerated the basic principles, let us enlarge on them in the order in which they were mentioned.

Working Sequence. Here, perhaps, more than in any other of the principles, will sacrifice have to be made to existing conditions. One can merely state the ideal and hope that adaptations and reconstructions can in some measure meet it.

From the studio itself it is logical that the first dark-room shall be the film or plate loading room. It is permissible here to deviate from the rule of spaciousness, as the room will seldom be occupied for more than a few minutes together.

Next in sequence comes the developing room, followed by the chemical mixing room.

The fourth and largest room will be devoted to printing, and the fifth to drying and sorting.

This "one-way system" (*see* plan opposite) presupposes the existence of five rooms, all occurring in their proper size sequence—such a fortunate coincidence is likely to be rare—but it should be remembered that much can be done by means of partitions of the pulp-board type ("Beaver" or "Essex"), and one has heard even of walls being removable!

In any case the rooms, both walls and ceilings, should be lined with pulp board, and finished with a white or cream enamel paint. The board serves the double purpose

of enhancing the general appearance and excluding dust, and when painted in the manner described can be washed down repeatedly. Distemper must be avoided on account of its tendency to flake and powder. Not so many years ago the fallacious belief that dark-rooms must necessarily be painted black held strong sway—a belief which in some quarters still lingers. Such a conviction endows ordinary white paint with the quality of begetting light of itself—a manifest absurdity, of course.

The best possible linoleum, fitting flush up to the walls and finished off with rounded beading, is a necessity. Rubber flooring is even better, but though doubtless an economy in the long run it has a high first cost. The far-seeing person, however, will do well to reflect on the exceptional amount of wear and tear to which dark-room floors are subject. Treatment of the rooms in this manner will do much towards cleanliness.

Ventilation and temperature are to a certain extent inter-dependent. A great deal may be achieved by the intelligent use and placing of electric fans and heaters.

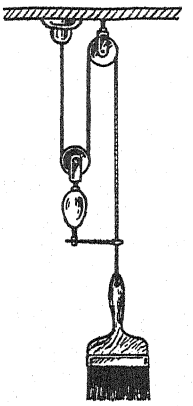
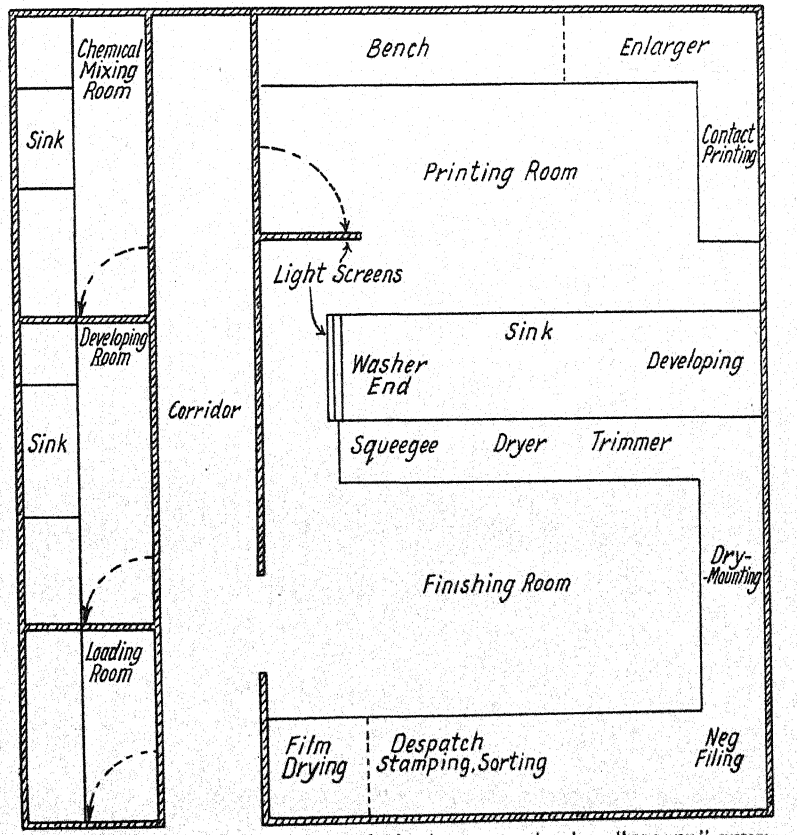


Fig. 2. Camel-hair brush attached to overhead counterbalance

When considering the question of equipment, the slogan " the best is the cheapest " still holds good. Therefore, the ideal dark-room's equipment is not exactly inexpensive. Again, one must make the best compromise possible.

Loading Room. The plate and film loading room needs no more than a single bench, fitted flush to and running the length of one wall. Under this bench will be fitted well-made wooden or metal drawers and shelves for the storage of the stock of films and plates. " A place for all sizes and all sizes in their place " would make an excellent motto here. Time spent in looking for a wanted size is time wasted.

The bench surface should be approximately two feet, with room for the packet of films on the right of the operative, for dark slides on the left, with depth enough to stand slides against the wall as loaded. An essential accessory is a flat camel-hair brush at least three inches wide. This should be hung close at hand. Dark slides about to be used can thus be given an internal brushing to rid them of dust. To prevent the brush itself from becoming dusty, it should be suspended from the ceiling via the conventional electric pulley (*see* Fig. 2).



PROFESSIONAL DARK-ROOMS. Fig. 1. Arrangement based on " one-way " system

And here a point—slides must never be stored without their draw sheaths inserted.

No dark-room lamp will be fitted in this room—the good operator needing no more than his sense of touch when loading. The one small general light should be of the enclosed type, fitting flush to the ceiling.

As soon as a box of films or plates is opened the contents should be placed so that the top emulsioned surface may lie face downwards. Stray fingers coming in contact with the plate or film are thus less likely to do damage.

Developing Room. Next in sequence one arrives at the film-developing room. Here the equipment must be most complete and very carefully considered.

The main furnishing, a bench and sink (fitted with two taps) may run the whole length of one wall if the room is fairly large, or the bench and sink may be at right angles, with the bench always to the operative's left. Both must follow the specifications previously given. Two developing tanks should stand on the left in the sink, a washer central, and an acid-fix hardening tank on the right.

Accessories will include swivel rods above both bench and sink to accommodate developing hangers. (The Kodak Co. make an excellent type of hanger which is adaptable to either plate or film. It embodies a spring-over clip running the length of the top edge—enabling it to be clipped on the swivel rod with a minimum of trouble.)

An immersion heater and a thermometer are essential, as well as the developing clock —an instrument of the type which rings an alarm when the pre-set developing time has expired.

Minor equipment will include a roller towel and a hand towel (the first to take up the bulk of wet chemical, the second on which to dry the hands thoroughly), a supply of fluffless linen plus a supply of ordinary spring clips.

Again a special dark-room lamp is considered unnecessary, an enclosed ceiling light being quite sufficient. When wiring the room an easily accessible and waterproof plug for the immersion heater must not be overlooked.

It is important that the immersion heater should be connected to a point to which is also coupled a low-consumption neon lamp. This will indicate when the heater is working, and prevent the premature burning-out of the element.

It will be quite obvious that a developing room so equipped presupposes the adoption of the " time and temperature " method of developing. In such a room the procedure would be, on broad lines, as follows : At the bench the slides are unloaded and their contents are transferred to the hangers which are in readiness on the swivel rod above the bench. Sheaths are then replaced in the slide and the slides themselves placed temporarily in a drawer under the bench out of harm's way. At the earliest convenient moment slides are to be returned to their rightful home in the loading room.

Choice of developing tanks now lies before the operative, for the first will contain a fairly fast commercial solution such as Kodak Time Standard (No. 3), which requires 7 minutes at 65°—the second will contain a moderately fine-grain solution, such as Kodak D76, requiring 16 minutes at 65°.

The films are placed in plain slides back to back to allow the developer free play round the emulsioned surfaces.

To keep these developers at an unvarying given temperature entails frequent use of the immersion heater and thermometer, and so those accessories should always be at hand.

Films should always pass through the washer before fixing, otherwise the acid-fixing bath will quickly be neutralized by accumulating alkalis from the developers.

When transferring from the fixing to the washing bath, films should be wiped gently with a wet swab of cotton-wool to remove any sludge.

Always, when using cotton-wool, beware of its tendency towards drain stoppage. A

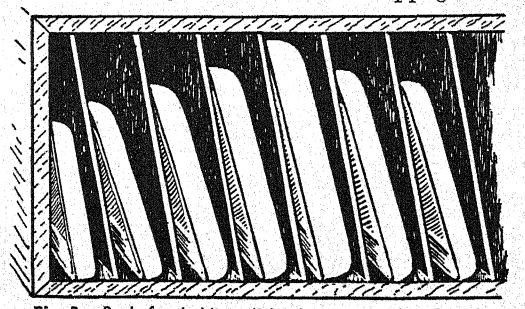
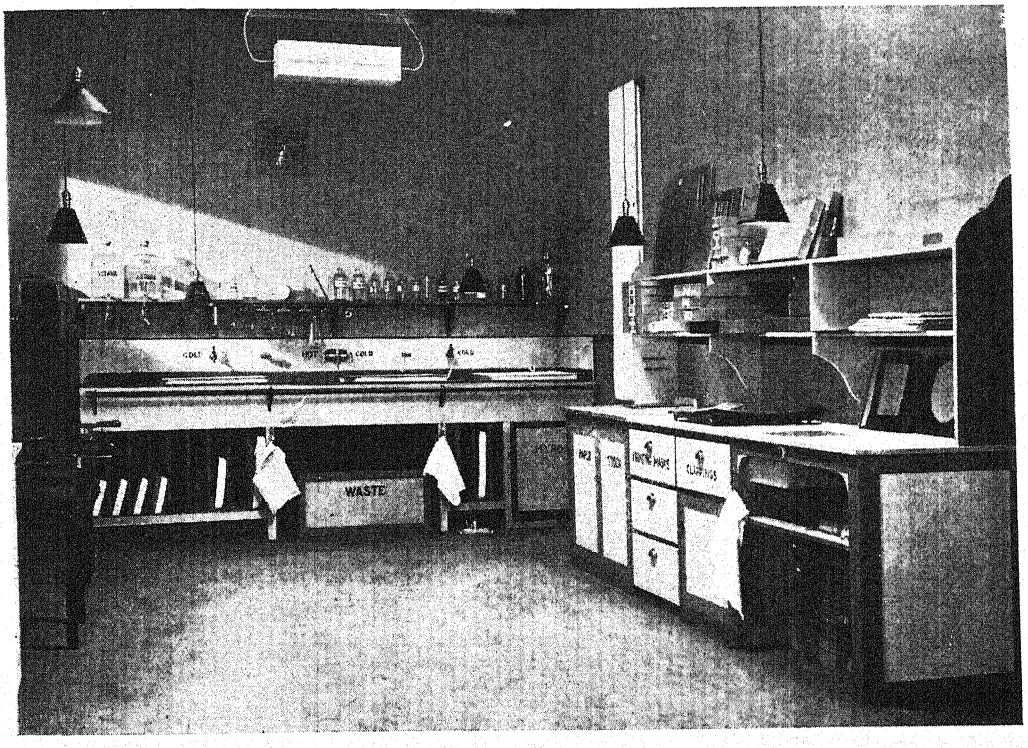
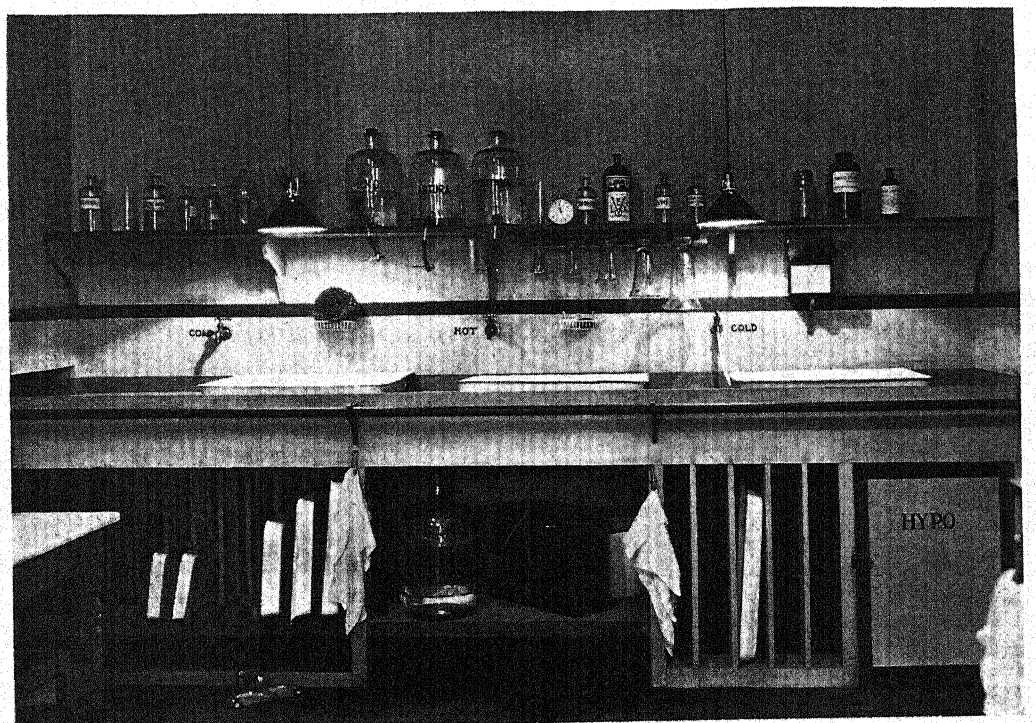


Fig. 3. Rack for holding dishes arranged beneath sink





PRINTING-ROOM LAYOUT. Two views of a Kodak model printing-room in which spaciousness, good lighting and careful arrangement are salient features. The disposition of the sinks, benches, racks, chemicals and general apparatus make for efficient and trouble-free work, and the room is a fine example of a photo-finishing department at its best

Photos, Kodak, Ltd.

cage of close-mesh galvanized wire for the storage of swabs will be found the most effective method of combating this nuisance. A small bin under each sink for waste is most helpful.

On removing films from the washer they are taken out of the hangers, blotted between the sheets of fluffless linen, clipped and hung up for draining. Hangers are then attached to the swivel rod over the sink, so that they too may dry.

Chemical Mixing Room. It must be considered an absolute essential that all chemical mixing be done in a separate room set apart for the purpose. This room must be used for no other purpose. No sensitized material of any kind should be left or stored here. The room will need, first and foremost, a commodious sink. Teak is without doubt the best material for all dark-room sinks. A certain quality of resilience makes such sinks far more sympathetic to bottles, plates, etc. than one of metal or glazed stoneware type.

Sinks should be at least nine inches deep, and where necessary fitted with anti-splash boards and provided with two taps of the swivel type, one having a length of rubber tubing and one an anti-splash fitting.

The next necessity is the bench on which chemicals are weighed, etc. Its top should be covered with linoleum or rubberoid, with

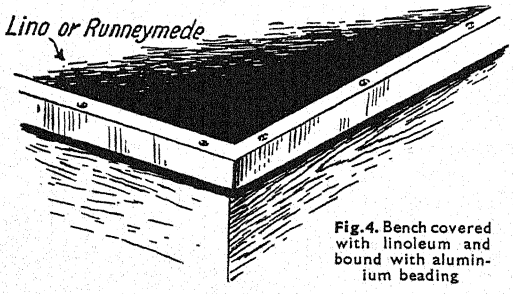


Fig. 4. Bench covered with linoleum and bound with aluminium beading

the edges bound and secured with aluminium angle lengths. These not only impart a neat and workmanlike appearance, but also enable the surface to resist the frequent washings to which it should be subject.

In drawers or on shelves fitted under the bench may be stored requisite chemicals.

Accessories will include two sets of scales—one registering grains up to the maximum of two ounces, the other having a range from two ounces to four pounds. There will be the indispensable gas-ring, various measures and funnels (safe accommodation must be provided for these when not in use) and, finally, a couple of kettles of generous size.

It might be noted in passing that on the rare occasions when distilled water has to be boiled or heated the employment of kettles normally used in the ordinary run of work will result in failure. Ordinary water invariably leaves behind it heavy deposits of foreign matter which would be transferred to the distilled water.

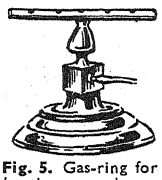


Fig. 5. Gas-ring for heating various solutions

A typewritten list of formulae should be placed where easily seen, mounted and varnished to resist damp and chemical attack. A set of stone vats with taps will be required for the storing of stock solutions. (All of these should be labelled with the nature and strength of their contents.) A good light of

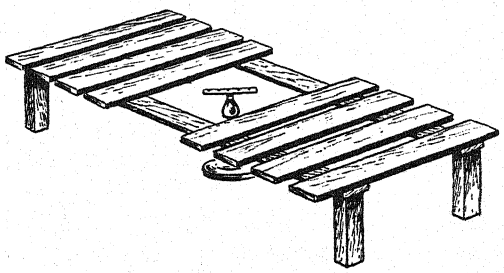


Fig. 6. Raised grid for taking developer dish with gas-ring for maintaining solution at constant and correct temperature

60 or 100 watts in enclosed ceiling fitting should be provided.

This completes the essential equipment.

So far as procedure is concerned, it should be a firm rule that once chemicals have been weighed and sorted on the bench, all actual mixing must be transferred to the sink. A measure and stirring rod are here indispensable.

Printing and Enlarging Room. The bigger and airier the printing room the better, as it will probably be occupied for the whole of the working day.

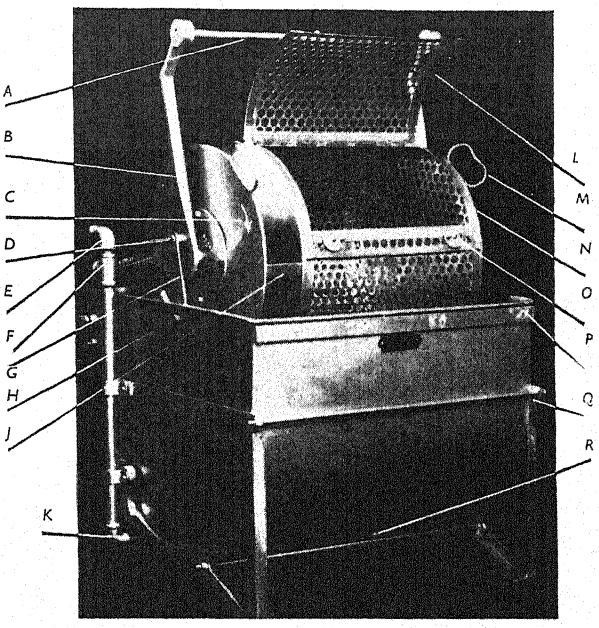
Naturally, the sink is one of the most important fittings and the " ideal " deserves a thoroughly detailed description to itself.

As such a sink will have to contain a large developing dish ; a stop bath or rinsing dish ; a combined acid fixing and hardening bath ; and, finally, a cascade washer—it will need

to be of a generous length and, except in the case of an unusually large room, will probably take up the entire length of one wall. Assuming that a print size 20 × 16 in. will be the largest size made under normal working conditions, a sink at least ten feet long will be required.

If the sink is made the suggested standard depth (9 inches) a raised grid should be constructed to take the developing dish. Such a grid will not only make for ease of working, but also will allow a small gas jet to be installed beneath the developing dish. This can be used to keep the solution at an unvarying temperature throughout the working day.

As M.Q., the most popular of developers, is practically inert at a temperature of 60°, while at its best at a temperature of 65°, one will appreciate the importance of this point. Therefore it would be wise to keep a thermometer more or less permanently suspended in the bath.



LARGE SCALE WASHING. **Fig. 8.** Kodak Rotary Washer. This machine is automatically operated. Air is fed into it at the point K with the water and sufficient power is developed to turn the cage at a speed of 12-16 r.p.m. The guide lines on either side of the illustration indicate : A, front grip rod ; B, lifting arm ; C, direction of rotation of cage ; D, cage bearings ; E, water feed pipe ; F, air intake valve ; G, strut ; H, stud ; J, vane ; K, air-water feed vent ; L, cage door ; M, cage handle ; N, cage ; O, cage door catch ; P, tank ; Q, cradle ; R, tank draining vent

Photo, Kodak, Ltd.

The developing dish will, of course, be on the left of the sink, the stop bath and fixing bath will occupy the next two positions, moving to the right, and both will lie on shallow grids and not at the full depth of the sink. (A supply of small movable grids, stored underneath the sink when not in use, is highly recommended.) The cascade washer will occupy the rest of the available sink space. This washer, possibly one of the most effective for commercial dark-room use, consists of a series of shallow sinks rising in tiers. The fresh water enters the first and highest (on the extreme right), drains through a series of holes into the next in the series, and so on, as shown in the accompanying sketch. Prints for washing enter the cascade in the lowest section on the extreme left and work their way upwards. For high-class portraiture and work of a similar character fifteen minutes per section is a sound rule, and will produce satisfactory results in most cases.

Limitation of space may render it impossible to instal such a washer. Should this be the case, further mention is given of two more compact and quite efficient washers.

The first—the Kodak rotary washer—is operated purely automatically and needs no attention. The prints are placed in a drum, which in its turn is contained in a cylinder. Water and air combined enter a series of cups at the end of the washing drum, causing it to rotate in the cylinder (*see* key to illustration above).

Possibly the simplest of washing arrangements is the ordinary dish fitted with an automatic siphon. The fresh water flows in from the tap and the tainted water is drawn

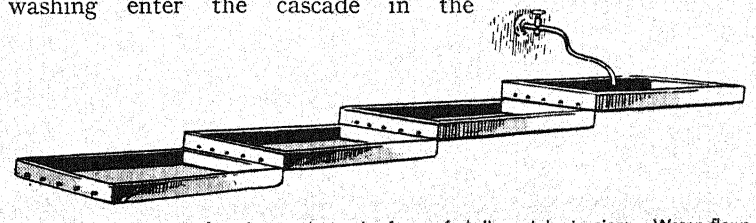


Fig. 7. Cascade type of washer made in the form of shallow sinks in tiers. Water flows through a series of holes, and prints placed in the lowest sink float upwards automatically

away from the bottom. This system is quite efficient for washing prints in small quantities.

To revert to general principles, the washer should at least end near the entrance to the glazing, drying and sorting room. An even better arrangement, if the washer ends flush with the partitioning wall between the two rooms, would be to have a hatch pierced and fitted with a warning bell and light-trap, so that time could be saved and workers in both rooms be in communication with one another. Washed prints could thus be passed through for finishing without delay, and there will be considerably decreased danger of their being damaged.

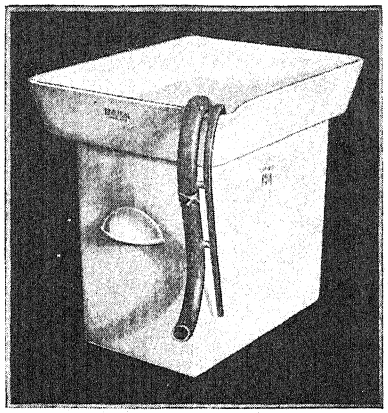


Fig. 9. Ensign dish with special siphon tube device. Water flows in from tap and is drawn off from the bottom
Photo, Ensign, Ltd.

Lights. The sink should be lit by an orange safelight of a type suitable to the general class of work anticipated. For instance, for conventional commercial work a Wratten Pyramid with a Series 1 safelight might be chosen, while for slower printing portraiture work Series 00 would be admirable. The Wratten Pyramid Lamp is described and illustrated in page 514 below.

In any case the light must be adjusted so as not to shine into the eyes of the operative. (Suspended above the dish and canted upwards towards the rear will be found the best position to avoid glare.)

A well-screened viewing light embodying a 60-watt pearl lamp will be placed directly over the fixing bath for viewing and reducing prints. This should be operated by foot pressure alone, leaving the operative's hands free for working on the print. Such a feat should be possible without harmful effects from escaping light if the lamp is in the right position. So far as the rest of the sink is concerned the normal dark-room lighting will suffice.

At the back of the sink shelves are required to take the necessary reducing chemicals etc. There must also be provision for Winchesters of developer.

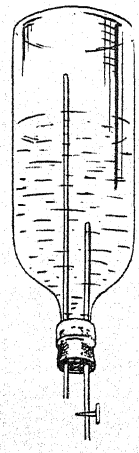


Fig. 10.

When a comparatively limited amount of work is expected it would be sound policy to provide for the Winchesters being inverted and fitted with a tube and tap arrangement—so preventing the passing out of any accumulated sediment (Fig. 10).

A spare tap placed centrally and fairly high over the sink—fitted with rubber hose and spray end, which is coiled out of the way—is a gadget for which a hundred diverse uses will be found. The space under the sink can be utilized as storage space—containing racks for spare dishes, etc.

The side of the room opposite the sink should be occupied by a bench and the vertical enlarger. The bench will carry negatives, layouts, instruction sheets, etc., and also house shelves for the larger sizes of paper used in the enlarger.

The Enlarger. The enlarger itself must be free of obstructions. Space all round is essential for easy movement when shading, etc. Choice of the make of enlarger rests entirely with the purchaser—there being many excellent types marketed (*see* Enlarger); but some special points might be noted.

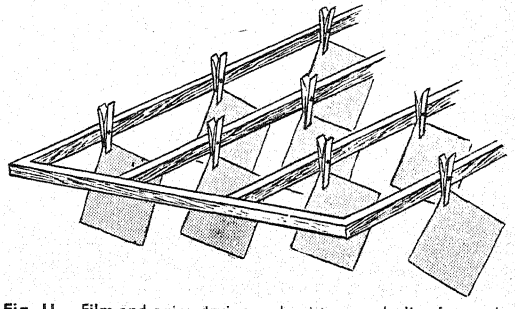


Fig. 11. Film and print drying rack with spaced clips for ready attachment and detachment

The horizontal type has a certain advantage over the vertical inasmuch as a greater degree of enlargement is possible.

The illuminant can also be placed in a room entirely apart, the light entering the enlarger proper through an aperture in the wall.

This prevents any leakage of light into the enlarging room itself (*see* sketch). Here it might be said that the condenser type of enlarger has the advantage of yielding a bright and amazingly sharp result, while the flashed opal or ground glass type produces enlargements of a softness more suitable to portraiture, etc.

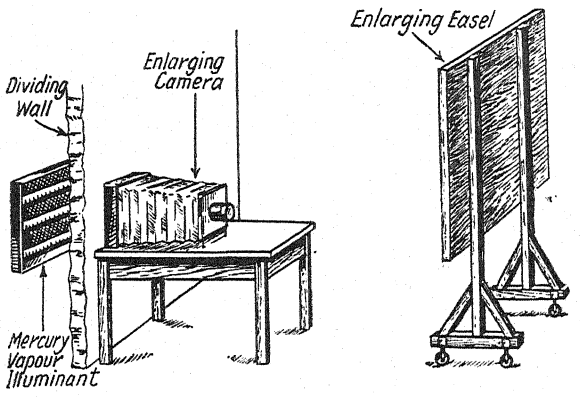


Fig. 12. MERCURY LAMP ENLARGER. Arrangement of horizontal enlarger with mercury vapour illuminant located in separate room. Light enters the enlarger through a trap in the dividing wall, the device ensuring that no leakage of light into the enlarging room occurs

The vertical enlarger's definite advantage lies in its compact nature, though it must be borne in mind that a ceiling must be high enough to take the full extension of the lantern. Also shading with the hands is much easier and "control" can be better seen during exposure.

On some instruments the movable lantern, camera and lens panel are supported at the sides—on others at the back.

The former type limits the size of paper in accordance with the width apart of its supports, but enlargements up to 40 × 30 may comfortably be produced on verticals of the "Sichel" type. It is well to remember that instruments such as the "Hilex" enable both enlarging and copying work to be produced by the same model.

The following comparison of illuminants might advantageously be borne in mind ; the first type—mercury vapour—costs but little to run and possesses the great advantage of coolness. It is, however, fairly costly to instal. The second type—half-watt—consumes rather more current and throws off quite an appreciable amount of heat. On the other hand, first cost is low when compared with mercury vapour.

If the half-watt illuminant is chosen, one point should always be watched if damage is to be avoided. Before using film negatives—particularly if they are on the dense side—both negatives and cover glasses should be thoroughly aired and so devoid of damp before being placed in the enlarger.

Should the planner wish to be really thorough—a separate lamp-house might be built. In this way both half-watt and mercury vapour could be installed giving the operative choice of the illuminant best fitted to the job in hand. Such an arrangement is not a necessity, but neither is it pure luxury if the planner is embracing the highest standards. A rheostat or dimmer for the maximum of light control could be a further refinement.

General practice proves that a choice of lenses is indispensable. These can either be fitted on uniform size but individual panels—for ease and speed of changing—or the two or three lenses likely to be in constant use can be mounted on one long panel—which in turn is mounted on a sliding or runner arrangement whereby the needed lens can rapidly be slipped into position.

Paper Holder

For the enlarger table a good paper-holder can be home-made. Materials required are an old picture frame complete with glass and a couple of tins of "Hektograph" composition.

First run "liquid cement" or adhesive tape around the glass where it meets the frame, to make a watertight joint. Then, while the contents of the tins are being melted in a saucepan of boiling water, slowly heat the glass over a gas-ring until it is quite hot.

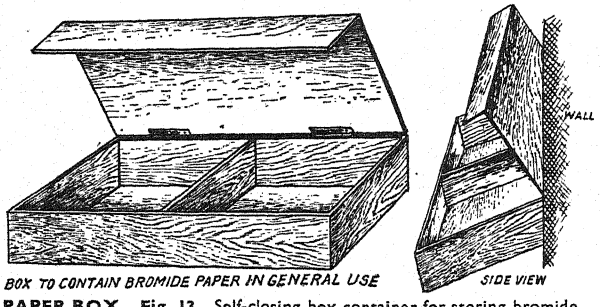
Next place the heated glass and frame on a perfectly flat, level surface (check this with a spirit level), then pour the composition, fairly quickly but evenly, over the entire surface of the glass.

Leave until cold, when the composition will be quite set. It will be found that on such a surface the bromide paper will lie perfectly flat if just smoothed down at the edges. Care should be taken not to injure

this surface with the finger-nails when removing paper after exposure.

The third angle of the wall contains a nest of drawers for the stock of paper and the printing box.

A word here about paper. Should it be anticipated that only two or three grades will be in constant use, it will be found an economy to have made box containers which automatically close after the withdrawing of the required paper. These are tidier, speedier in action, and safer to use than are the card-board boxes in which paper is supplied. (A sketch of such a box is appended.)



PAPER BOX. Fig. 13. Self-closing box container for storing bromide paper. The container is attached to the wall and the lid falls automatically when the hand is withdrawn

A supply of clean, clear glass cut to various sizes should also be stored conveniently hereabouts for enlarging from films and the making of odd-size masks.

On the subject of printing boxes much could be written and many individual tastes quoted. For general commercial work, however, certain rules must be observed.

Printing Box. First, the box should have an illuminant of nine to twelve evenly distributed 40-watt lamps—and, in addition, the usual red pilot light.

Possibly this might be considered by some an excessive amount of light, but it is essential that perfectly even illumination be obtained, and such lighting is vitally necessary.

Immediately above the lamps should be placed a sheet of pale yellow glass, and above this again (and just below the top plate glass) a sheet of ground glass.

The purpose of the ground glass is to carry shading tissues, masks, etc.

The yellow glass not only carries the sought-after ideal of absolutely even illumination a stage further, but by increasing the exposure time it brings into existence a certain amount of compulsory control.

Under such conditions a negative of normal density will require about four seconds exposure, using bromide paper—an admirable standard. One has observed printers giving no more than a fast " up and down " of the contact pad, and even then finding the exposure overfull. Such conditions are certainly not conducive to good printing, and also lead to much unnecessary waste of paper. It is, of course, possible to add to any printing box the refinement of a dimmer or rheostat for further control.

Recently a well-known photographer had constructed to his own specification a printing box designed to cope with difficult negatives—negatives which normally would require much laborious cutting out of varied thicknesses of tissue, etc.

The box had no contact pad, pressure on paper and negative being applied by a sheet of plain white plate glass held in position by spring clips. The switch was operated by foot pressure, leaving the hands free for local shading. The sides of the box were left open on this account. Furthermore, the plate glass pressure pad rendered the feat easy to accomplish. Such a box, obviously, would need adequate screening.

Some might consider this box an unnecessary elaboration, but a modification of the idea in the form of a pressure pad supplied with the machine will be found extremely useful in practice. The normal pad is inclined to give more or less poor contact when it has become worn, and has not the merit of transparency.

If one anticipates orders of prints in large quantities from, perhaps, copy negative work, a large printing box (approx. 20 × 16 in.) would be a sound investment. Such a frame could deal with four whole plate negatives to one exposure, thus saving time and expense in production. There are several makes available—out of which one is inclined to recommend the " Boardman," with its ease of light control. A trap opens in front of the frame, where additional opal glasses can quickly be inserted without difficulty—the illuminant being of a direct diffused light type.

Admittedly there are in existence types using reflected light—but they have the

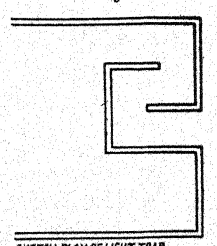
disadvantage of bulkiness—extra space being required for the shielded lights under the printing base. Unless the " direct light " type are very adequately diffused they cannot claim such an even quality of lighting as can the " reflected light " type which, on the other hand, are slower in operation though using similarly powered lamps.

Printing Room Lighting. General lighting of the printing room will include an orange safelight (a 60-watt lamp in an amber glass cover, from any photographic equipment dealer, is adequate), and ordinary lighting for when no printing is taking place. Should it be so desired, a combined lamp doing the double duty can be bought.

Actual recommendation might be extended to the " Kodapan " Unit Illumination, which uses reflected light only. The lamp is designed to light efficiently but safely a working area of 30 square feet with a ceiling height of not more than 10 feet. Should the ceiling exceed this, the " Kodapan " must be used in conjunction with a specially manufactured reflector.

Minor details of equipment in the printing room will include : roller and hand towels in easy-to-hand positions ; a large dial seconds clock ; a special drawer near the printing box in which can be kept the many odds and ends so useful to the printer—details like a steel rule and a celluloid rule ; cardboard and plasticine, together with a supply of stout but pliable wire from which can be made a variety of roughly shaped shading tools ; a dusting brush and duster ; tubes of black and crimson water-colour paint and spotting brushes for minor negative adjustments ; a 12-inch or larger paper trimmer ; and finally an easily cleaned metal rubbish bin.

Drying and Finishing Room. The sequence ends with the drying and sorting room. Ready means of access to the printing room should be provided by means of sliding light-trap doors in addition to the hatch already mentioned —the main purpose of that being the quick dispatch of the wet prints from the printing room.



SKETCH PLAN OF LIGHT TRAP ENTRANCE.

Fig. 14

An alternative arrangement (and better one if considerable " traffic " is expected) is the light-trap entrance, which is constructed with pulp-board and quartering and explained by the accompanying sketch.

This final room should also be as commodious as circumstances permit, as quite possibly it will be the busiest.

It must be well lighted, as all operations requiring safelights are now concluded.

Immediately beneath the communicating hatch should be the squeegee bench. A slightly inclined surface covered with " Runnymede " rubber flooring should be finished off with a three-inch wood surround, the whole surface of the bench thus becoming a large tray for the collection of water. There must, of course, be provision for drainage. On the extreme left of this bench a small portion should be isolated for the reception of wet prints arriving through the hatch. Under this bench provision could be made for the chromium glazing tins, which must be kept perfectly clean, free from dust and organic matter. Wipe and dry in the same manner as you would heat a mirror ; on no account use metal polish or violent rubbing.

If preferred, it is possible to buy a rolling-out board with a cover and water tray combined. This is quite efficient if not quite as solid as the foregoing arrangement.

It is opportune to insert here the rule that all drying, whether by heat or by natural means, shall be kept apart from the dark-rooms proper. The same rule must likewise apply to any toning that might be required.

In this orderly serial there now follows the drying and glazing machine—which can be electrically or gas heated and fitted with an automatic cut-out operating when a maximum temperature is reached. It should further possess a sprung pressure pad as in the Agfa type. Such a pad ensures close contact between the prints and chromium plates, obviating those irritating and unsightly collections of tiny air spaces which so mar the glaze. An excellent utility machine is 24 × 16 in.—a machine of these measurements being able to accommodate one print measuring 20 × 16 in. or four prints 10 × 8 in.

For drying unglazed and matt prints a cupboard should stand next to the glazer.

It should contain an electric fan and a small heater plus a nest of frames. These frames are covered with butter muslin on which the prints are laid face down. The number of prints that one is able to dry in an accessory of this description is extremely astonishing.

Still travelling to the right, the next item in sequence would be a fairly spacious bench for the accommodation of the print trimmer and dry mounting press. The latter may again be electrically operated, with a red warning rear light fitted to avoid wastage of current. Provision should also be made for a small gas-ring—required for heating the mounting irons.

Underneath and above this bench drawers or shelves must be fitted for the storing of mounts, tissues, wax mounting sheets, etc. Further provision should be made for a spotting desk, with individual lighting placed so that the worker will not be compelled to dodge his own shadow.

Then follows the negative racks, the office section of the filing system and the negative drying cabinet. Here, one might say, is the directing intelligence of the whole dark-room procedure.

From the drying cabinet to the right of this office section negatives can be sorted, attached to their related data, and handed into the printing room. On the left are returned negatives waiting for disposal and storage. A really competent person in charge here can make the difference between smooth, flowing efficiency and complete chaos, and tidy habits are essential.

In this room, also, and with the same person in charge, should be stored the main stock of sensitized material. Metal lock-up cabinets are ideal for this purpose.

General Considerations. For the lighting and heating, number all switches and their respective fuses; in the event of a fuse blowing little time is then wasted in locating the right number. Main white light switches should always be distinctive and quite separate from all others. An easily accessible main switch near the entrance door is advisable, and this should be switched off when closing the rooms.

Switches likely to be handled with wet or damp hands should either be of the ceiling type operated by pull cords (handles should be painted with a luminous paint for when working in complete darkness), or should be of the bakelite heavily insulated type. There should, of course, be only a ruby light in any connecting corridor from which stray rays may penetrate dark-rooms.

For the purpose of economy all dark-room lighting should be installed on the power rate instead of on the lighting rate, as this is considerably cheaper.

The construction of the rooms described could, perhaps, be best carried out in a basement—always provided the ventilating facilities are adequate. One is thus saved the problem of the elimination of unwanted daylight, and in addition the question of a perfectly controlled temperature is more easily solved.

The serial operations outlined in this article (and illustrated by the accompanying sketch plan in page 503) will not only help in systematic running and the easy flow of work, but will also help considerably in maintaining discipline.

Bad dark-room organization will bring its own troubles in its train—slovenliness, slipshod methods, carelessness, waste, and, more important still, a general decline in the quality of the work done will almost inevitably result in a proportional decline in the sum total of the volume of business which is entrusted to the firm.

Smooth working also leads to smooth tempers—with a consequent lack of those internal dissensions which are the cause of so much harm. A contented and efficient staff is the first signal on the road to ultimate success and is fairly easy to ensure if only a little foresight and tact are exerted on the part of those who are in charge of the business.

One final warning. The wise administration will be constantly on the watch for any signs of over-confidence. Any excess of confidence in the infallibility of staff and equipment means, sooner or later, the entrance of carelessness and lack of attention to what have come to be regarded as finicking details. A keen eye and a quiet word in the right quarter now and then will work wonders in keeping the system always at the very peak of its form.

The really good photograph needs and deserves constant care throughout *every* phase of its production. That is the fundamental truth which must always be observed.

DARK-ROOM: (4) ITS PROPER ILLUMINATION

J. C. A. Redhead, F.R.P.S.
Of Kodak, Ltd.

The illumination of dark-rooms is often regarded as an awkward one for the amateur in particular to solve. It will be seen, however, in the following article that for both amateurs and professionals various form of safelights are available which provide for efficient results and comfortable working conditions. The recommendations for lighting when working on various kinds of films and of printing papers are of particular value

THE problem of dark-room illumination is as old as photography itself. In the early days, however, it was a comparatively simple one because sensitive materials were slow and "colour blind," and the danger of fogging was therefore relatively small. Improvised safelights could be used with impunity, and because of this, little scientific consideration was given to the question of dark-room illumination.

Since those days the manufacture of sensitive materials has made enormous progress, and with this progress dark-room illumination has become a matter of the utmost importance.

Sensitivity of Materials

Emulsions have become faster—that is, more rapidly sensitive to light and therefore more easily fogged—and they have become more colour sensitive—that is, they may be fogged by light of colours which would be perfectly safe with "colour-blind" materials.

But although for these reasons great care should be exercised in selecting and fitting up the illumination of a dark-room, it does not follow that a photographic work-room needs to be inconveniently dark. The essential point is that the light used shall be *safe*, and provided it is safe there is no reason why there should not be plenty of it.

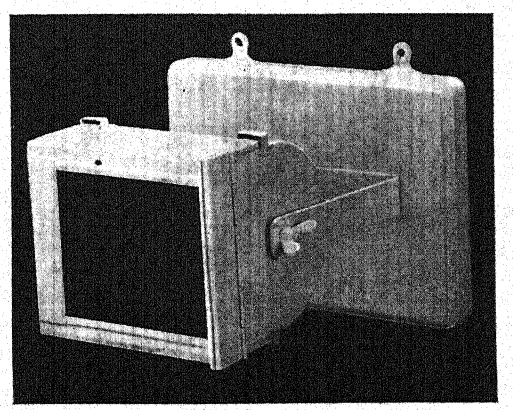
Indeed, the term dark-room today is something of a misnomer. Even when dealing with panchromatic materials it is possible to light the room sufficiently well to see and work in comfort after the eyes have become accustomed to the greenish illumination which is recommended for this type of material. It would therefore be more appropriate to refer to a "dark-room" as a "work-room," though in view of the fact that dark-room has by usage become the universally accepted term, its use is maintained in this article.

"Safety" is, of course, a relative term. The standard adopted for Wratten safelights is that if the specified dry sensitive material is exposed for 30 seconds at a distance of three feet from the surface of the recommended safelight, no fog is produced on development —the use of the safelight in a Wratten Standard Lamp fitted with a bulb of recommended power being assumed.

This standard has its basis in normal photographic practice because in ordinary use dry materials need never be exposed for longer than 30 seconds, and when placed in the developer they become less sensitive.

In order to maintain safe yet comfortable lighting in a dark-room the best method is to employ two types of illumination—general and local. General illumination, lights the room all over; local illumination provides stronger light where necessary.

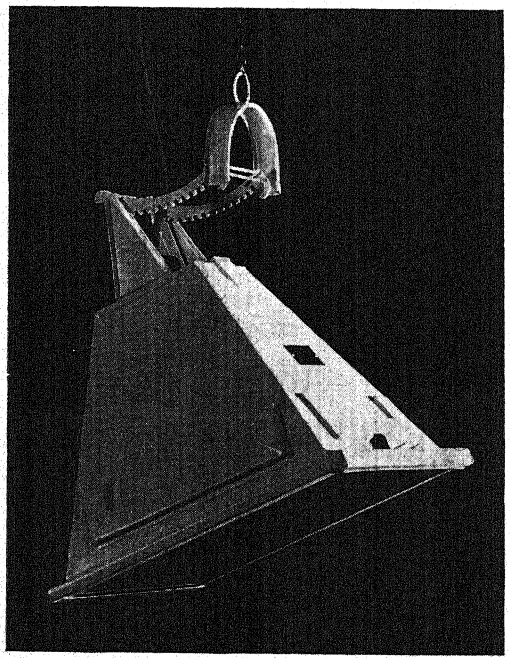
For general illumination a special type of lamp has been designed. This is suspended from the ceiling; the light is thrown upwards through a safelight and is reflected downwards from the ceiling to illuminate the room. If the ceiling is broken or uneven,



KODAPAN WALL UNIT. The wall unit seen here is designed on the same principles of illumination as the ceiling fixture illustrated in page 515, but whereas the latter is intended for general illumination, this lamp throws the light in a specific direction. The side pivots enable the user to raise or lower the lamp at will

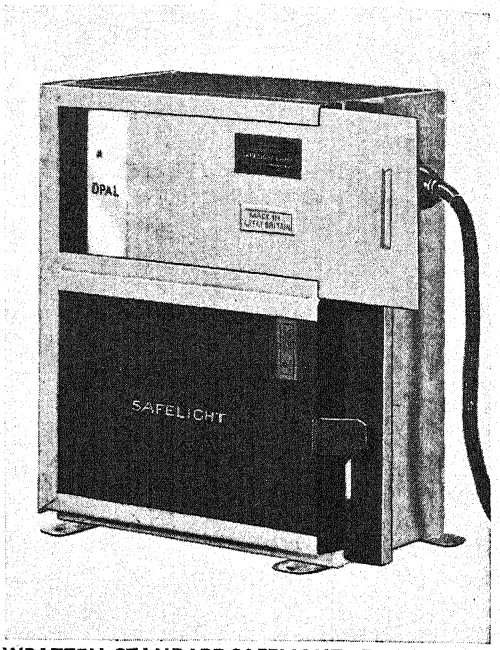
then a suitable reflector is suspended between the ceiling and the lamp ; and this reflector is also desirable if the ceiling is more than ten feet high, as otherwise the strength of the light reaching the lower part of the room will be too greatly diminished. The ceiling should be painted white to secure the greatest possible degree of reflection from it.

Needless to say, the question of whether indirect illumination is used at all will depend upon the amount of work which the photographer does in the dark-room, and probably many amateurs will feel that they are prepared to dispense with the added convenience of general illumination. At the same time it should be remembered that comfortable working conditions do have a perceptible influence on the quality of the work which can be turned out and consequently general indirect illumination is recommended where possible. For dark-rooms in which a great deal of work is done, as, for example, in photo-finishing works, general illumination is, of course, indispensable.



WRATTEN PYRAMID LAMP. This lamp is especially suitable for workrooms in which a ceiling fitting can be satisfactorily hung. One of its chief advantages is that an adjustable rack at the top enables the user to adjust the direction of the light as he wishes

Various forms of safelamp are available for local illumination.

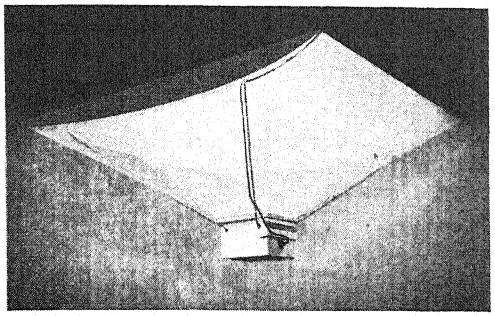


WRATTEN STANDARD SAFELIGHT. This lamp fitting is a very useful accessory in any dark-room because no ray of light can be seen when it is entirely closed and when the slides are open no direct light emerges. An advantage of the fitting is that the light can be easily changed to suit the sensitivity of the material being handled

Photos in this page, Kodak, Ltd.

Probably the most generally useful type of lamp is one which will stand on a bench and can be placed where required, or screwed into position. A well-known type of lamp, the Wratten Standard Safelight, is illustrated in this page. No direct light is transmitted by this lamp and the safelight can be changed at will according to the sensitive material which is being handled. Another type of lamp is that which is suspended from the ceiling ; the one illustrated in this page is the Wratten Pyramid Lamp, which is fitted with an adjustable rack so that the light can be directed at various angles.

The price of safelamps varies from a few shillings upwards, and the best advice that can be given to any photographer is that he should purchase the best lamps that he can afford. Safelamps must be light-tight, and they must be capable of remaining in use for a considerable period without danger of overheating. If overheating occurs the structure of the lamp may be affected and the safelight may be damaged. The purchase of a cheap lamp or an attempt to use a home-made lamp will usually be found to be false economy.



KODAPAN CEILING UNIT. This lighting fixture provides general illumination in the dark-room without permitting direct rays to fall on any sensitive material, since all rays strike the ceiling and are then diffused and reflected. The unit is carefully made to avoid the possibility of stray rays finding an exit directly on to work in hand

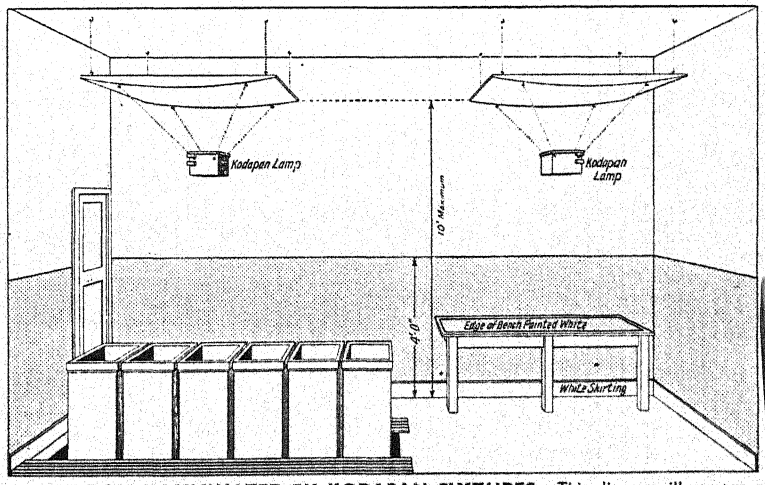
Great care should be taken to use the type and strength of illumination—whether it be electric, oil or gas—which is recommended for the particular type of lamp, as otherwise the light which is given may not be safe. Very seldom is an electric lamp of greater power than 40-watt gas-filled pearl type recommended—usually a 25-watt pearl (not gas-filled) lamp is correct.

The actual safelight—that is to say, the translucent material through which the illumination passes—varies according to the material which is being handled. The most scientifically correct form of safelight is obtained by using sheets of gelatine or other material of the required colour between two pieces of glass.

For developing orthochromatic negative materials a suitable red safelight may be employed, but if panchromatic materials are going to be handled a light of a green colour has to be employed. Although panchromatic materials are sensitive to all colours and therefore theoretically would be fogged by light of any colour, it is possible to use a type of green illumination to which the retina of the eye is far more sensitive than is panchromatic film. This is the type of light used for Kodapan illumination. The light given is exceedingly dim, but after a few minutes the eye becomes "acclimatized" to it, and it is then quite sufficient for comfortable working. The light is indirect, being reflected from the ceiling or—if the ceiling is broken—from reflectors suspended from the ceiling. A loading cabinet to hold films awaiting development is necessary, since this prevents direct light from striking them. To secure entirely successful results, the Kodapan illumination should be installed in accordance with the makers' instructions; the diagram in this page shows a typical photo-finisher's workroom.

For the manipulation of bromide papers a safelight of an orange colour is indicated. Although bromide papers are often fast, if a properly and scientifically made safelight is used it is surprising how much illumination can be employed without fear of spoiling material; deep orange light is not necessary. The use of one of the modern bromide safelights is of the greatest assistance both for novice and expert. In the illumination provided by such safelights as these there is no need, in developing, to allow for the fact that the light is of a different tone from that in which the print will eventually be seen; development can be carried to the same depth as will be finally required.

For large bromide workrooms general illumination is usually used; the light being reflected down from the ceiling or from a



WORKROOM ILLUMINATED BY KODAPAN FIXTURES. This diagram illustrates a photo-finisher's workroom, showing the amount of illumination recommended and the packing of fixtures in relation to working tables. The same principles are equally applicable to other types of photographic workrooms

Copyright, Kodak, Ltd.

reflector, as described. For amateur use, local illumination will normally be enough.

Gaslight papers, which are much slower than bromide papers, do not call for the use of a safelight, but nevertheless printing becomes a much pleasanter and more convenient operation if a safelight is used. The safelight recommended for gaslight papers is yellow. A special type of lamp has been designed for use in printing rooms of finishing works for providing Velox Illumination (*see* D. & P. Work, page 493). This hangs from the ceiling and throws light upwards, to provide illumination by reflection from above. At the same time, a beam of safelight is directed downwards for direct illumination.

Many photographers, both amateur and professional, have been inclined to take the term dark-room too literally. Apart from using lamps which gave less illumination than can be perfectly safely employed, walls, doors and ceilings were frequently painted dead black. Today the modern dark-room is usually painted white. So long as the light is *safe* the more it is reflected, the more convenient are working conditions. It is far wiser to have white walls with safelight than black walls with unsafe light.

DARK SLIDE. The holder of a sensitive dry plate, with which it is inserted in the back of a camera, is called a dark slide ; with the plate it replaces in the camera the ground-glass screen after focussing is complete. It consists of a holder proper, and a front shutter which is withdrawn after insertion into the camera. The dark slide may be double or single. The former are either open, *i.e.* book-form, when one plate is placed in each side, or else solid, in which case the two plates are introduced into an opening at one end. These dark slides, not in general use by the amateur, are usually of wood.

Single dark slides are generally metal, being made of either aluminium or thin iron, and hold one plate each. The plate, film side up, is placed in the holder, where it is retained by spring clips, and the front shutter is slid into grooves in the holder, covering the plate. A light-trap of plush lies along the top of the slides. Two points to be noted by the amateur are (1) the necessity for placing the plate in the slide film side outwards so that when the front shutter is withdrawn the plate faces the interior of the camera ; (2) the necessity for careful placing of the front shutter squarely on its grooves to avoid lifting the light-trap and so admitting a streak of light ; and (3) the necessity for keeping the slide entirely free from dust, which, if it settles on the emulsion, will prevent light-action and so produce what are known as " pinholes " in the negative.

DEFECTS IN NEGATIVES AND PRINTS

The finished print may suffer from one or more of a number of defects which may be avoided with a little caution. Mr. W. L. F. Wastell, Hon. F.R.P.S., describes these defects and points out their remedies. In the second part of the article Mr. S. W. Bowler, A.R.P.S., throws further light on the problem in regard to cine negatives

It is very important for the modern photographer to do all in his power to prevent the possibilities of scratches, spots, or any similar defects in his negatives. This is the case because most workers use small, or " miniature," sizes, and the slightest imperfection renders the negative useless.

Fog. Most defects met with on film negatives are due to lack of care in handling the spools. Many photographers fail to realize that even when the spool is wound within its protecting paper, if the latter is not tight, or if the spool is exposed to very strong light, fogging at the edges is inevitable.

Care must therefore be exercised to keep the film tight upon its core after the securing band has been broken, when loading. If the operation must be done in strong light, only sufficient of the backing should be unrolled to thread into the receiving spool.

Care must be taken when threading the paper that it will run straight. Neglect of this means edge fog, or the film may become jammed, particularly in the case of very small cameras where the space in the spool chambers is reduced to the minimum. (*See further under* Fog.)

Light Traps in Slides. In most metal dark slides the safety shutter draws right out before an exposure is made. In some cases the only provision for excluding light is a strip of plush or velvet. In time the pile of the velvet becomes worn and flattened so that it no longer fills the slot, with the result that the negative is fogged at the upper edge.

Handling Film Packs. These should be kept in their cartons both before and after exposure, and when loading or unloading them the front of the pack should never be touched. Pressure on the front will inevitably fog the edges of some of the films. The tab should be pulled with a steady, continuous motion so that it runs straight through the slot. It is as well to put a finger on the remaining tabs while changing the exposed film, as this prevents moving of the next film at the same time.

Reticulation. Reticulation is a form of shrinkage of the light-sensitive emulsion on a negative and takes the form of tiny " crinkles " in relief either all over or on only part of the negative. There are several factors which can contribute to this, but the most usual is that of using a warm developer and a cold acid fixing-bath. Reticulation is dealt with under its own heading.

Scratches on Negatives. The roll-film user needs to be especially careful to avoid the several causes of scratched negatives.

The familiar " telegraph line " scratches, which run across the film in the direction that the film travels through the camera, are generally the result of some roughness on the surface over which the film runs. It may be due to the rollers being too tight, or the pressure plate exercising its function too strongly.

Care must be taken not to wind the film with the camera closed, there being so little clearance between the film surface and the bellows that there is risk of scratching the film. Another point that needs attention is that the camera must be free from dust, or grit ; the latter, especially, if coming into contact with the film while the latter is being wound, or under pressure, will certainly cause scratched negatives.

Provided that it is properly threaded, the well-designed camera will permit the film to be wound with sufficient tightness to prevent light from entering. Some photographers, when removing the spool after exposure, twist the spool to tighten it with a view to preventing the admission of light. This practice is to be deprecated, for not only is it unnecessary, but it is a very fruitful cause of scratches.

Pinholes. These are due to small particles of dust on the surface of the plate when the exposure is made, so that they naturally keep light from reaching the emulsion. To avoid this it is necessary to keep the interior of the camera and the dark slide (both inside and out) dust-free.

Pinholes can be treated on the negative by a touch with a fine pen lightly charged with indian ink.

Spots. A very common defect is the white clear spot, due to air-bells upon the film during development which prevent the solution from reaching the emulsion. Care in working, swabbing the surface of the plate or film during development will prevent these, as will the use of water that has been boiled and allowed to cool for making up solutions.

Tear-Drops. Rapid drying is often responsible for " tear-drop " markings on the films. Since these are most objectionable and are difficult to remove it is advisable to sponge all surplus water from the film surfaces before commencing to dry. This is best done with the aid of a chamois pad saturated in water and wrung out immediately before commencing the swabbing.

A viscose sponge is a very useful accessory for wiping down films prior to drying.

Blue Spots. The spots are generally the result of minute particles of iron rust in the tap water. A remedy is to tie a double thickness of flannel over the tap to filter the water. As regards the prints you can remove the spots by applying to each a touch of hydrochloric acid diluted to half strength.

Yellow Stains. These may be due to stale or exhausted developer ; too short or too long rinsing between development and fixing ; or prolonged development in an attempt to remedy under-exposure.

Poor Blacks. Unsuitable developer, frequently too much or too little bromide ; over- or under-exposure ; poor quality paper ; contrasts too strong or too weak ; grade of paper not suited to negative.

Brown or Purple Stains. Prints floating partly above the surface of the fixing bath, or partially sticking together during fixing.

Foggy High-Lights. Stale or badly stored paper ; developer too strong or too warm ; unsafe dark-room light.

Uneven Image. Development shortened to counteract over-exposure ; developer kept stagnant instead of gently moving.

Stained Bromide Prints. The following is an effective clearing solution for bromide prints which are stained generally or locally, or of which the whites are not quite clean. Make up a stock solution:

Iodine	60 grs.
Potassium cyanide	60 ,,
Potassium iodide	120 ,,
Water	10 ozs.

Add only three or four drops to an ounce of water, and apply with a plug of cotton-wool. Wash well. The cyanide is a scheduled poison, and only a small quantity need be obtained, and the rest dissolved and washed down the drain.—*W. L. F. WASTELL, HON. F.R.P.S.*

DEFECTS IN CINE NEGATIVES. These may be classified under the two headings of chemical and mechanical. Chemical defects are generally due to undissolved constituents of the various solutions used, which settle on the film and prevent the even action of the rest of the solution. Incorrect mixing of the solutions may also cause part of the chemicals to settle out of solution in a flocculent state. Always see that the chemicals are dissolved either in the order in which they are given in the formulae or else according to the special instructions issued with the formulae. Uneven action of any solution may be due to insufficient agitation of the frames, racks or tanks in which the film is placed. General poor quality of results, or untraceable peculiarities, may be due to cheap or inferior chemicals being employed. *Filter every solution before use.*

Mechanical defects are generally due to sheer carelessness in handling the film during manipulation in the processing solutions. Scratches may be caused in this stage of the proceedings, or may be due to a dirty camera. To settle this point, run a piece of blank film through the camera and examine carefully without processing. Scratches may also be introduced in the printing operation. Apart from the fact that the apparatus may be defective, which is generally unlikely, such defects may be traced to carelessness or badly cleaned and maintained equipment. The remedy for such faults is to avoid handling the film as far as possible in the wet state, when the emulsion is swollen and delicate. Where high temperatures are met with, some form of hardening solution should be used at one stage of the proceedings or another. Before putting the film to dry, it should be wiped down to remove scum, excess moisture (to prevent drying marks due to drops of water standing on the celluloid side), etc. For this purpose, damped chamois leather or a slit viscose sponge should be used. Unless this is kept scrupulously clean, it may itself also cause scratches on the film through accumulated grit or dirt in the pores of the material.—*STANLEY W. BOWLER, A.R.P.S.*

DENSITY AND DENSITY METER. The density of a silver deposit in a negative, a transparency or a print is a measure of the blackness, or light-stopping power, of the deposit. A density of 1 is one which transmits 1/10th of the light falling upon it, and a density of 2 transmits only 1/100th. From this readers familiar with the idea of logarithmic scales will observe that density is equal to the logarithm of the reciprocal of the transmission. The shadows of a normally exposed negative will be of density about 0.1 to 0.4; and the high-light density, with average subjects, about 0.8 to 1.5, according to the degree of development. The arithmetic difference between shadow and high-light densities gives the *range* of the negative—often loosely termed the *contrast*—and it is to this value that the printing paper must be matched if a full scale of tones, from white to black, is required in the print.

For the amateur the measurement of these densities may be made by the use of a simple form of density meter, such as the E.S.S. Density Meter. In this instrument a chosen small area of a negative, which fills one half of the field within an eye-piece, can be matched against one of the densities of a graduated step-wedge, which fills the other half; when the two sides have been matched in tone by sliding the step-wedge across, the density of the negative at that point can be read off by the position of the scaled step-wedge. Density readings thus obtained provide a basis not only for the choice of suitable paper but also for the judgement of printing time.—*T. L. J. BENTLEY, D.I.C., B.Sc., A.R.P.S.*

See also Contrast; Negative, Density and Tonal Values; Prints, Density and Tonal Values.

DEPTH OF FOCUS AND HYPERFOCAL DISTANCE

Leo A. Leigh, B.Sc., A.R.P.S.

The two subjects explained and discussed in this article are of a technical nature, but since precision in photography is as much dependent upon sound theory as upon skilful practice, these matters are dealt with at considerable length. In addition to defining clearly the terms "depth of focus" and "hyperfocal distance," the article contains practical examples with graphs specially prepared by the author which show how to make calculations relating to these two factors and how to apply them in daily work

See also Disk of Confusion

WHEN a lens is focussed on a plane, the definition both in front and behind that plane will gradually fall off, until the lack of sharpness becomes so apparent that the eye will no longer tolerate it. Between these limits definition will be acceptable, the distance between nearest and farthest sharp planes being called "depth of focus."

The actual limit of permissible unsharpness depends on the disk of confusion (*q.v.*) chosen, and all subsequent examples as well as the accompanying graphs have been worked out for a disk or circle of confusion of $\frac{1}{250}$ in.

Hyperfocal Distance. The distance on which a lens must be focussed to give the greatest depth of focus which will then extend from infinity to half that distance. In "fixed-focus" cameras the lens is focussed on the hyperfocal distance to give maximum depth of focus.

In snapshot work with a hand camera it often happens that there is no time to focus accurately on the subject itself. By selecting an appropriate aperture and focussing the camera on the hyperfocal distance for that particular stop, the camera may be converted into a "fixed-focus" camera covering the range of the subject. Thus if we suppose that a camera fitted with a 5-in. lens is used for street scenes where the main subject occurs at any distance between, say, 40 ft. and infinity, then in order to avoid re-focussing for various distances the lens is stopped down until the depth of focus will cover the required range (40 ft. — ∞), the lens being focussed on the hyperfocal distance.

The hyperfocal distance itself can be obtained from the following formula:

$$\text{Hyperfocal distance} = \frac{F^2}{f} \times \frac{1}{C}$$

where the hyperfocal distance is in INCHES
F = focal length of lens in INCHES.
C = circle of confusion in fraction of an INCH.
f = lens stop number.

In the example chosen, if the lens is stopped down to *f*8 the hyperfocal distance will be:

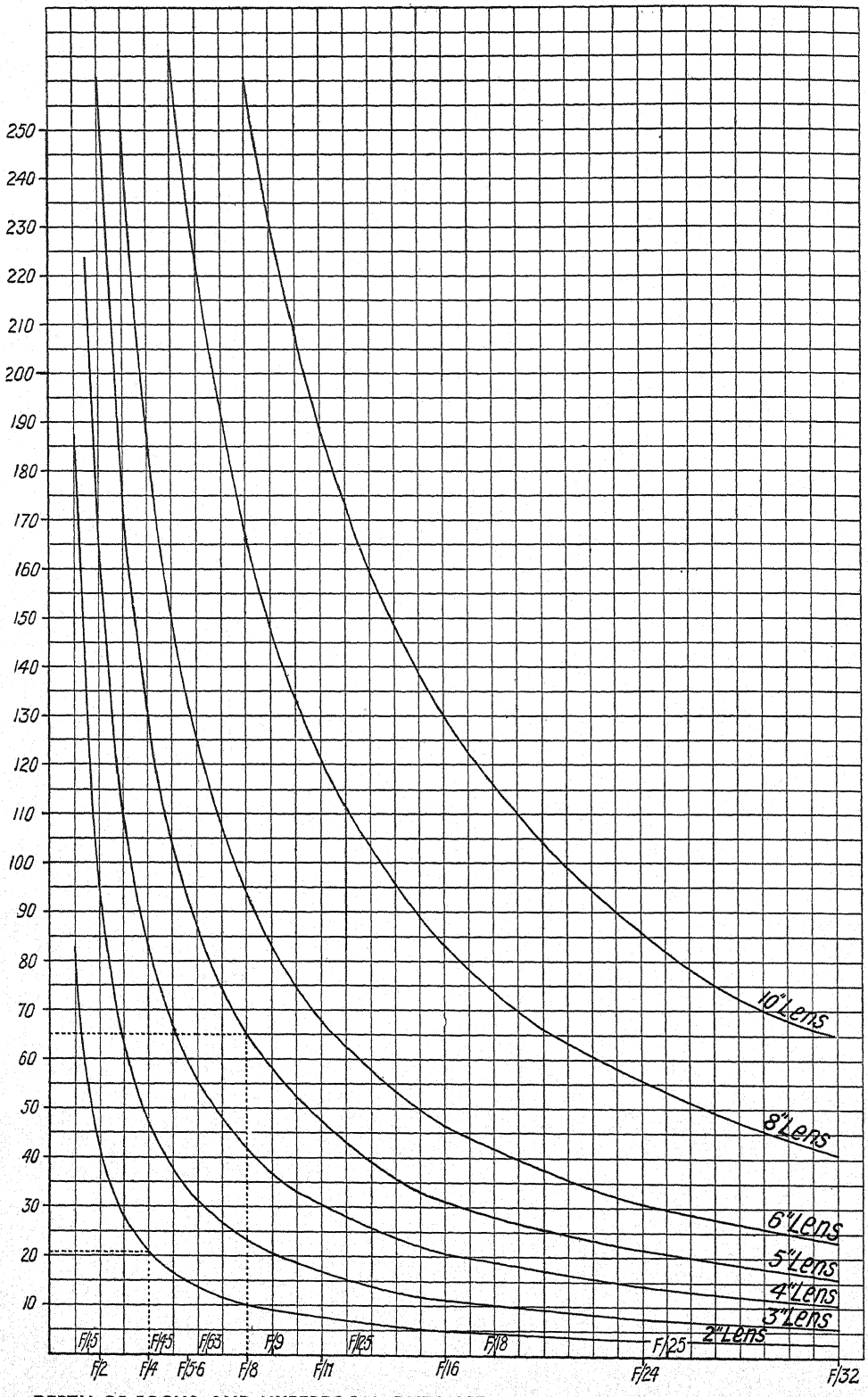
$$\frac{5^2}{8} \times 250 = 781 \text{ in.} = 65 \text{ ft., } 1 \text{ in.}$$

If, then, the camera is focussed on that distance, everything between infinity and 32 ft. $6\frac{1}{2}$ in. will be in focus (within the permissible amount of diffusion, *i.e.* $\frac{1}{250}$ in.) which will be sufficient to cover the range of the subject.

Graph No. 1. Instead of making use of the formula given above, the values of the hyperfocal distance can be read off directly from the graph (p. 520), which shows the variation of hyperfocal distance with lens aperture for lenses of various focal lengths. The graph is drawn to scale and the hyperfocal distance can be read off for any aperture between *f*1.5 and *f*32. Thus, in the example chosen, if we look up *f*8 on the horizontal scale we simply run a vertical line until it meets the curve of the 5-in. lens and read the corresponding value of the hyperfocal distance on the vertical scale, which gives us 65 ft. The small discrepancy between the calculated value and the value obtained from the graph can be neglected.

Graph No. 2. This graph (p. 521) shows the variation of hyperfocal distance with the focal length for various commonly used apertures, and it can be used for finding out the hyperfocal distance of lenses of any focal length between 1 in. and 10 in. at apertures of *f*2, *f*4, *f*5.6, *f*8, *f*11 and *f*16.

Suppose we wish to know the hyperfocal distance of a $5\frac{1}{4}$-in. lens working at *f*8. We look up $5\frac{1}{4}$ in. on the horizontal scale, produce a vertical line until it meets the *f*8 curve and read off the corresponding value on the vertical hyperfocal distance scale, which in this case gives us 72 ft. (The corresponding value obtained by calculation is 71.7 ft.)



DEPTH OF FOCUS AND HYPERFOCAL DISTANCE (Graph No. 1). Drawn to scale for direct reading
Disk of Confusion $\frac{1}{250}$ in. Specially prepared by Leo A. Leigh, B.Sc., A.R.P.S.

Conversion For Other Circles of Confusion. The values of the hyperfocal distance given by Graphs No. 1 and No. 2 have been worked out for a circle of confusion of $\frac{1}{250}$ in., but they can be corrected for any other circle of confusion simply by multiplying the value obtained from the graph by $\frac{1}{250}$ and dividing the result by whatever circle of confusion has been chosen.

Thus the hyperfocal distance of a 2-in. lens working at *f*4 is given by the graph as 21 ft., and it is required to know the hyperfocal distance for a circle of confusion of $\frac{1}{750}$ in. This will be:

$$21 \text{ ft.} \times \frac{1}{250} \div \frac{1}{750} = 21 \times \frac{750}{250} \text{ or } 63 \text{ ft.}$$

(By calculation 62 ft., 6 in.)

Depth of Focus. Having found the hyperfocal distance, it is possible to calculate the nearest and the farthest planes at which the definition will remain sharp within the arbitrarily chosen limits.

If H = hyperfocal distance in FEET (not inches)
D = Distance on which lens is focussed (FEET)

$$\text{Then the nearest sharp plane} = \frac{H \times D}{H+D}$$

$$\text{and the farthest sharp plane} = \frac{H \times D}{H-D}$$

Thus, if a 5-in. lens working at *f*8 is focussed on 15 ft., the nearest sharp plane will be:

$$\frac{65 \times 15}{65+15} = \frac{975}{80} = 12.2 \text{ ft.;}$$

and the farthest sharp plane will be:

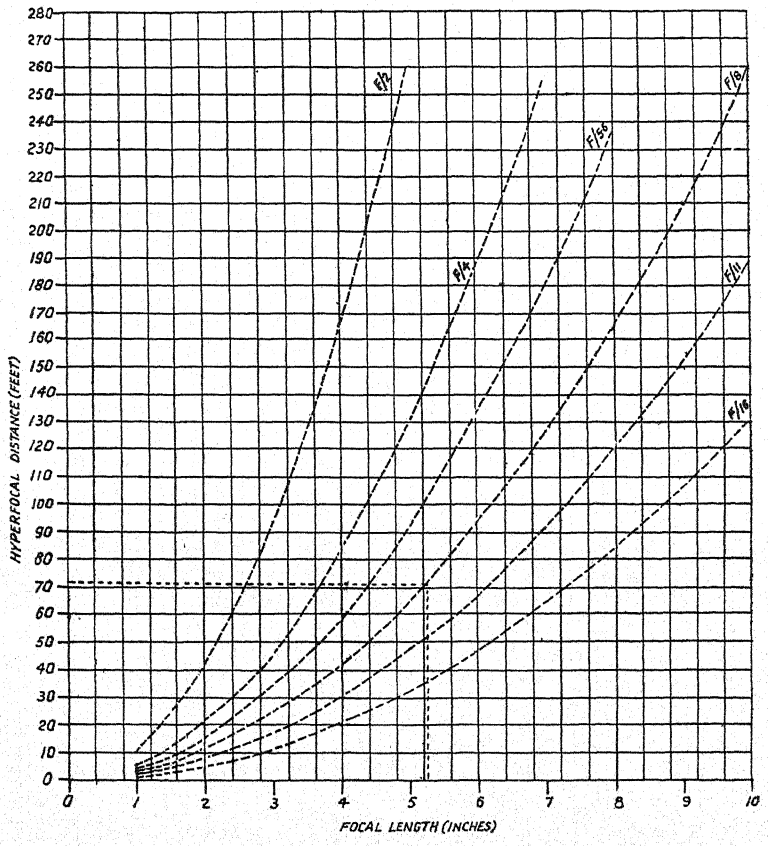
$$\frac{65 \times 15}{65-15} = \frac{975}{50} = 19.5 \text{ ft.}$$

So that the depth of focus will extend from 12.2 to 19.5 ft.

Graph No. 3. This graph has been worked out for a 5-in. lens and shows the actual depth of focus for apertures of *f*4, *f*5.6, *f*8 and *f*11. To obviate crowding of the figures at the lower ends of the scale and also to make readings more accurate, curves are plotted on a logarithmic basis, abscissa and ordinate being scaled proportionally to the logarithms of the distances.

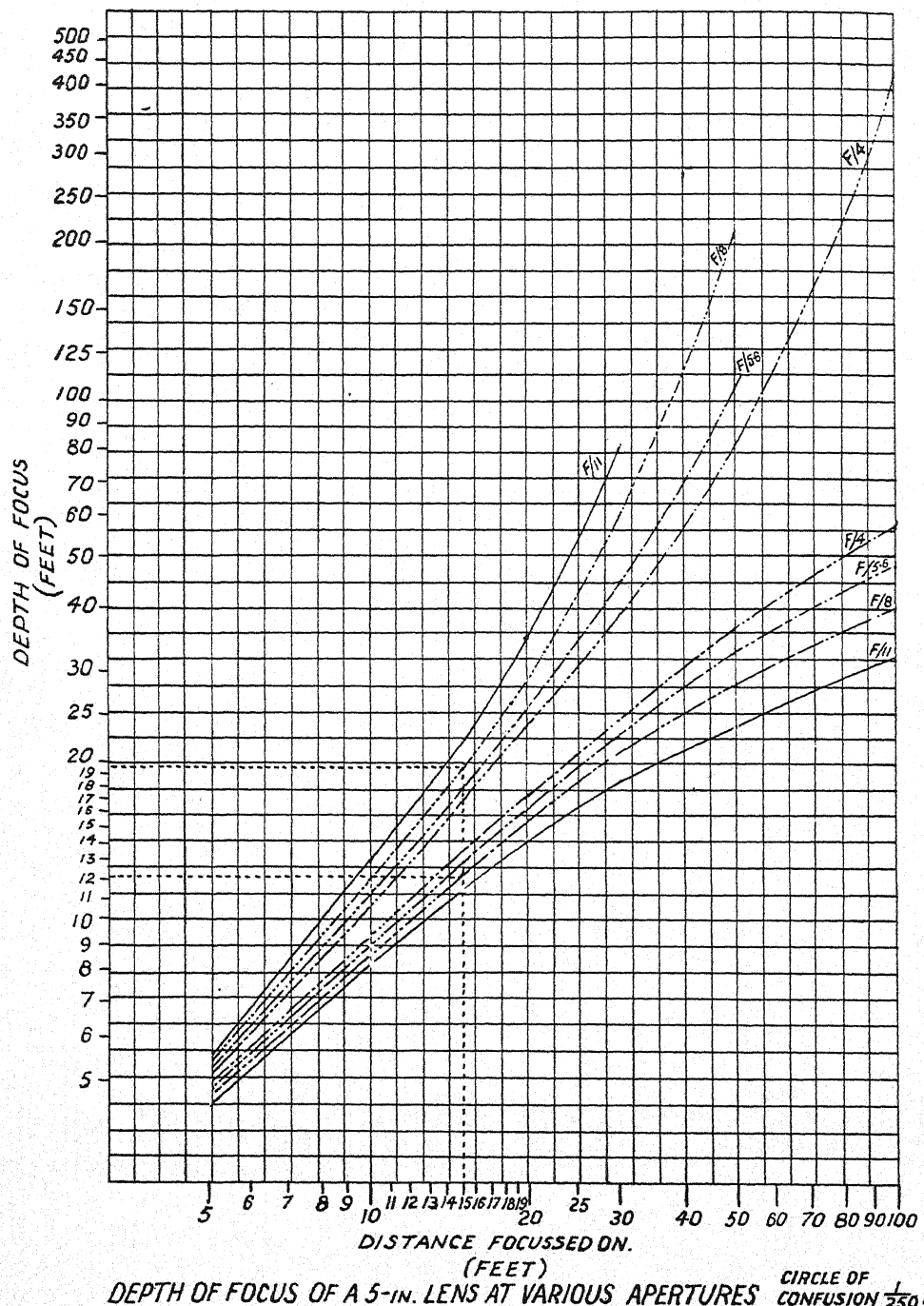
The curves run in pairs, each pair being marked with an *f* number. The top curve of each pair represents the farthest sharp plane and the corresponding lower curve shows the nearest sharp plane at the same aperture.

As an example, suppose that we wish to know the depth of focus of a 5-in. lens working at *f*8, when focussed on 15 ft. From the 15-ft. mark on the horizontal scale we run a vertical line to meet the two curves marked *f*8. The points of intersection correspond to 19.5 ft.



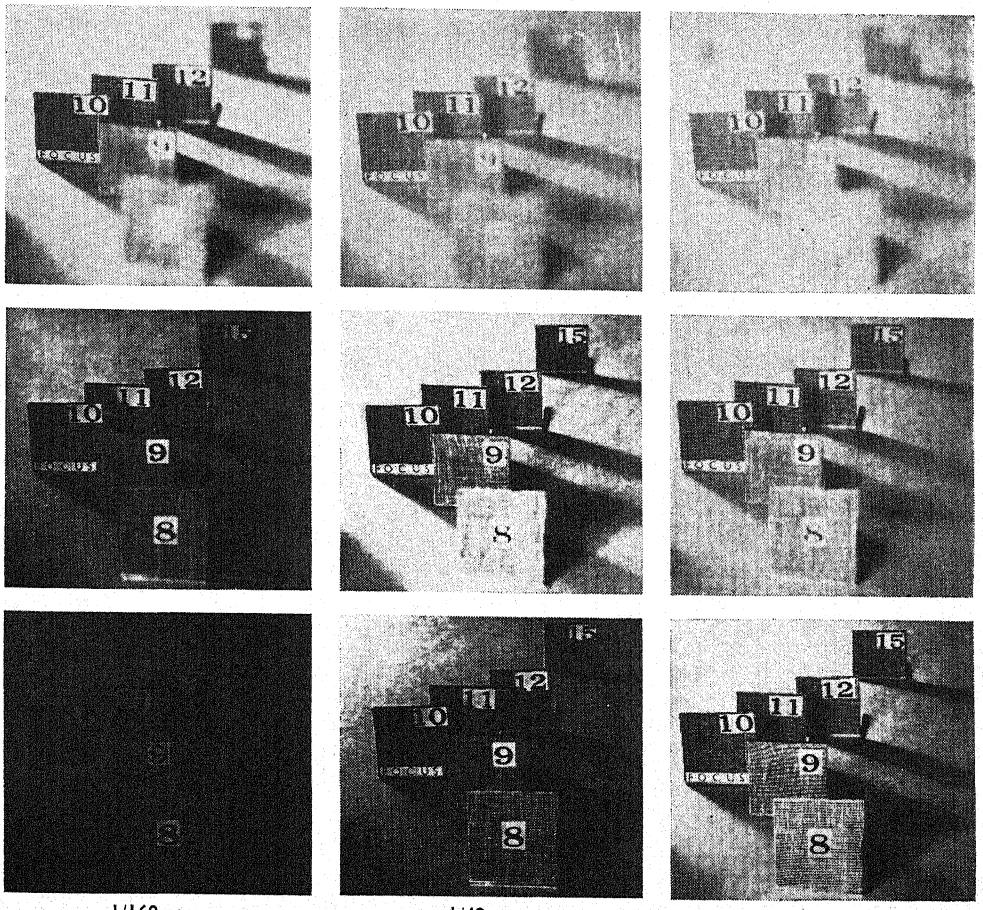
DEPTH OF FOCUS AND HYPERFOCAL DISTANCE (Graph No. 2). Hyperfocal distance is found by producing vertical lines from horizontal scale to meet appropriate curve. Corresponding value is given in vertical scale calibrated in feet. Disk of Confusion $\frac{1}{250}$ in.

Specially prepared by Leo A. Leigh, B.Sc., A.R.P.S.



DEPTH OF FOCUS (Graph No. 3). Graph used for calculating depth of focus of 5-inch lens. Curves are plotted in pairs, the top one of each pair representing the farthest sharp plane, the bottom curve showing nearest sharp plane at the same aperture

Specially prepared by Leo. A. Leigh, B.Sc., A.R.P.S.



APERTURE AND DEPTH OF FOCUS. Six photographs of numbered cards showing the effect of aperture on depth of focus. The *top row* was taken with *f*2 and in each case card 10 is sharp but the focus does not cover a foot in front. The exposure is correct at 1/160 sec., but with 1/40 sec., and 1/10 sec., there is over-exposure. At *f*4 (*second row*) there is an improvement in the depth of focus, but a longer exposure (1/40 sec.) was required, under-exposure and over-exposure occurring at 1/160 sec. and 1/10 sec. respectively. At *f*8 (*bottom row*) all photographs have right depth of focus, but under-exposure occurred with 1/160 sec. and 1/40 sec. Correct exposure was 1/10 sec.

and 12.2 ft. on the vertical scale, *i.e.* when this lens is stopped down to *f*8 and focussed on 15 ft., everything between 19.5 ft. and 12.2 ft. will be in focus, which agrees exactly with the values obtained by calculation. Similar graphs can be prepared by the reader for lenses of other focal lengths and for any aperture required. It is simply necessary to calculate the depth of focus at various distances and to plot the results in the form of a curve, preferably on a logarithmic basis.

Focussing for Maximum Sharpness Between Two Planes. If it is necessary to have good definition between two planes, this can be achieved with the minimum amount of stopping down by focussing the camera on an intermediate plane, which is given by the following formula.

$$\frac{N \times F \times 2}{N+F}$$

where N = distance of the nearest plane
F = distance of the farthest plane

By setting the scale to the distance given by this formula and looking up the depth of focus table or graph, we shall see how far to stop down the lens in order to obtain the necessary depth of focus.

Suppose it is required to have good definition on all planes between 12 ft. and 20 ft., using a 5-in. lens. The camera should be focussed on :

$$\frac{12 \times 20 \times 2}{12+20} = \frac{480}{32} = 15 \text{ ft.}$$

DESENSITIZING

Fig. 3. The diluted desensitizer is poured into the developing tank in daylight

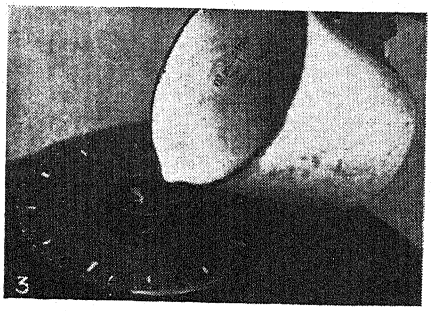
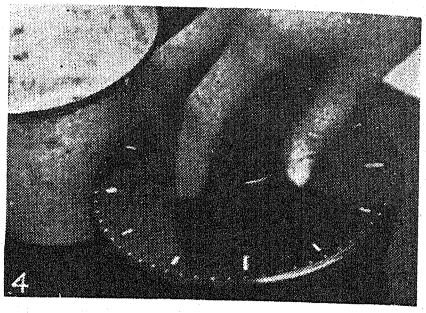
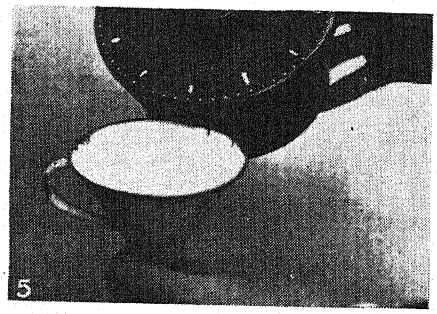


Fig. 4. The film is next agitated gently for one minute





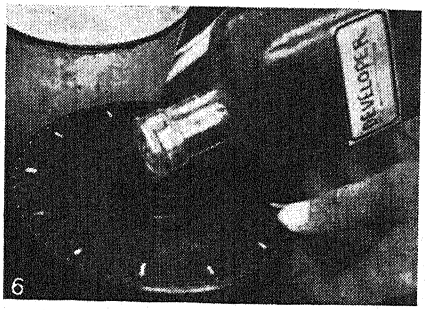


Fig. 5. The Desensitol is afterwards poured off and bottled for future use

Fig. 6. The tank is next filled with developer in the normal manner, and can be examined in ordinary dark-room light if desired

testing is unnecessary, since the backing dyes employed do not affect Desensitol.

Of the general properties of Desensitol, the following are in its favour: (1) It is extremely stable in solution, the solution keeping indefinitely without loss of desensitizing power, even after hundreds of negatives have passed through it. (2) It is an efficient and rapid desensitizer, 1–2 minutes immersion in the diluted solution being sufficient for all types of plates and films. (3) It has no harmful action on the photographic emulsion, there being no increase of fog and no loss in the density of the latent image formed by the original exposure even after prolonged immersion in the solution.

The only important defect of Desensitol as a desensitizer is its staining action. Desensitol in solution is coloured bright red, and tends to leave a pink stain which can be removed only with difficulty from plates and films by prolonged water washing. Although for some purposes a slightly stained negative shows no disadvantages, because of its staining action Desensitol cannot be used for colour plates, *e.g.* Autochrome, or colour films, *e.g.* Dufaycolor, Kodachrome, etc., where no interference with the colours can be tolerated.

Pinacryptol Green. Pinacryptol Green is a desensitizer which has enjoyed considerable popularity abroad. It is available both as a 1 : 500 stock solution and in the solid form. For use as a pre-bath the stock solution is diluted with 20 times its volume of water, or the solid is dissolved in 10,000 parts of warm water and the solution cooled to the normal working temperature of 64° F. Although Pinacryptol Green can be added to some developers, it is not suitable as an addition to the common developers which contain hydroquinone, and it is preferable, therefore, as in the case of Desensitol, to use Pinacryptol Green solutions exclusively as a pre-bath.

The points in favour of Pinacryptol Green as a desensitizer may be described as follows:

(1) Although its solution is green in colour, it is easily removed by washing from plates and films, and so shows little tendency to stain. Its use for colour materials alone cannot be recommended. (2) It is an efficient and rapid desensitizer, two minutes immersion in the diluted solution being sufficient for effective desensitizing. (3) With panchromatic materials its desensitizing action is more powerful than that of Desensitol.

But Pinacryptol Green possesses several unfavourable properties which affect considerably its value as a desensitizer. Thus, it

has a decided tendency to cause chemical fog on the plate or film, and cannot therefore be recommended for use where very clean negatives are essential. It causes a slight loss of image densities, too, so that prolonged immersion in the desensitizing solution is inadvisable. Finally, solutions of Pinacryptol Green will not keep indefinitely, although it should be noted that they may be kept quite well for some time in a brown bottle in the dark.

Pinacryptol Yellow. Pinacryptol Yellow is the most recent of the common commercial desensitizers, and for many purposes is displacing the Pinacryptol Green which comes from the same manufacturers. Unlike the other desensitizers, it is sold in powder form alone, and, because of its low solubility, must be dissolved in boiling water before the working solution of 1 : 2,000 can be prepared. Since the desensitizing action of Pinacryptol Yellow is partially destroyed by the sodium sulphite normally present in developers, it must be used in solution as a pre-bath only.

Pinacryptol Yellow possesses the following advantageous properties which are the main reasons for its success as a practical desensitizer :

(1) Its 1 : 2,000 water solution is very pale yellow in colour, and has no staining action on any photographic material. It is therefore the only one of the desensitizers available commercially which can be used safely with colour plates or films. (2) It is a rapid and extremely powerful desensitizer when used in the recommended strength, two minutes' immersion being sufficient for all purposes. (3) Its desensitizing action on panchromatic material is even more powerful than that of Pinacryptol Green. (4) It is a clean working desensitizer, and in normal practice it causes little or no chemical fog on the negatives.

The main disadvantage of Pinacryptol Yellow is its effect on the latent image, slight losses of density occurring as with Pinacryptol Green. As with the latter, therefore, plates and films should not be immersed longer than the specified time in the desensitizing solution. Of less importance is the fact that Pinacryptol Yellow like Pinacryptol Green will not keep indefinitely in solution. If stored in a brown bottle in the dark-room, however, the solution may be kept for months without appreciable loss of its desensitizing power.

The Technique of Desensitizing. This is essentially the same for all desensitizers used as a pre-bath, the procedure being as follows :

The desensitizing solution, made up to the prescribed strength, is placed in a dish which is deep enough to avoid spilling and of such a size that the plate or film when immersed is completely covered. If ordinary or orthochromatic materials are being employed, these are bathed in the solution for about two minutes in complete darkness, or by the light of the usual dark-room lamp, and then transferred either directly, or after a rapid rinse in water, to the developer. The dark-room gas or electric light is then turned on, or a shaded candle a few feet away may be used. During development it is preferable that the operator should work with the developing dish in a position where it is shaded from direct light.

It must be remembered that no desensitizer completely destroys the original sensitivity of the photographic plate or film.

After two to three minutes in the developer the negative may be examined with safety by holding it up momentarily to the light. The use of a diffuser, interposed between the light and the negative as a protection and aid to examination, is not advised, since it renders more difficult the judging of densities. When the desired density has been attained, the negative that is being treated is rinsed and finally fixed in the normal manner.

With panchromatic plates and films bathing in the desensitizing solution for about two minutes in complete darkness is absolutely essential.

The procedure of development is then similar to that described for ordinary materials, except that only a shaded candle or a special safelight, *e.g.* a bright green safelight, can be employed. Greater care must also be taken that direct lighting is avoided during development, since even after desensitizing has taken place there is quite an appreciable amount of red sensitivity left in panchromatic materials, and artificial lighting is, of course, rich in red light.

DEVELOPERS : (1) CHIEF CLASSES AND CHARACTERISTICS

David Charles, F.R.P.S.

This is the first of a series of fourteen articles on Developers, Developing and Development, in which Mr. Charles surveys the developers now in use, their ingredients, their compounding and use. The sequence continues thus :

DEVELOPERS : (2) Standard Formulae, by A. L. M. Sowerby
Special Chart of 110 Makers' Formulae for Negative and Paper Developers
DEVELOPING : (1) Principal Methods Considered, by F. J. Mortimer
(2) The Dish Method for Plates and Films
(3) Factorial Development (Watkins Method), by David Charles
(4) Tank Development (Time and Temperature), by David Charles
(5) Selection of Modern Tanks
(6) Film Packs, by W. L. F. Wastell and C. Kirk
(7) Miniature Films, by R. G. Lewis
(8) Fine-Grain for Miniature Films, by A. L. M. Sowerby
(9) Physical Development, by Stanley Bowler
(10) The "Instantaneous" Method, by F. J. Mortimer
DEVELOPMENT : (1) The Scientific Basis, by H. Baines, D.Sc.
(2) The Theory Applied, by W. L. F. Wastell

All the above apply almost entirely to negative development. For paper development refer to Bromide Printing ; Gaslight Paper ; Prints, Density and Tonal Values.

See also Contrast ; Negative, Density and Tonal Values ; and also Chart of Manufacturers' Developing Formulae

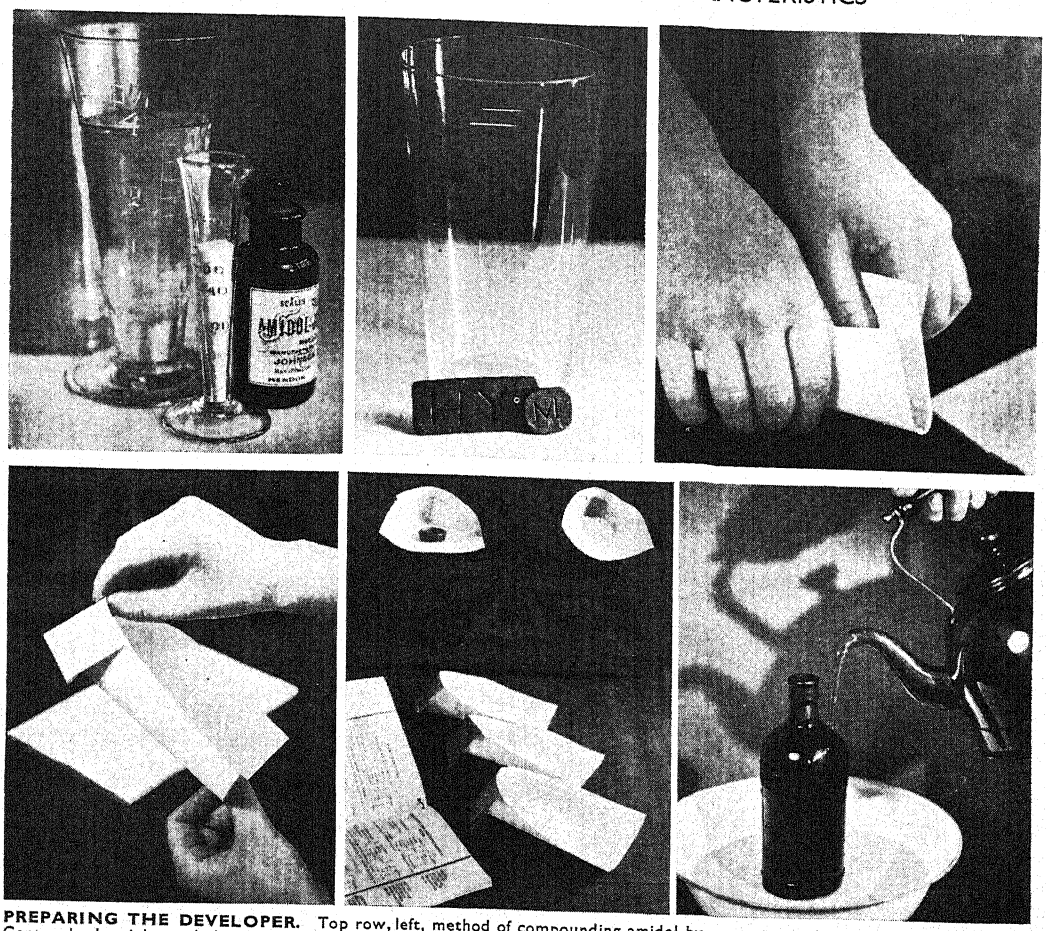
A DEVELOPER is a solution of chemicals which converts the invisible "latent" image into a visible image of metallic silver. "Agents," which are the essential ingredients of developers, are nearly all of "aniline," *i.e.* coal-tar by-product, origin. They are many in number, and still more numerous in name.

Purposes of Ingredients. A single "agent" dissolved in water is not a suitable developer by itself. It is necessary to mix with it an alkali, usually sodium carbonate. This alkaline addition is often called the accelerator, mainly because it was once the custom to add excess of alkali to speed up the process. All developing agents are substances which oxidize readily, and an alkali is necessary to assist this characteristic. But if a solution is prepared which consists of an agent and an alkali only, the former will oxidize rapidly, even immediately, and will be destroyed.

Consequently it is necessary to add an ingredient which will tend to prevent any such chemical action within the solution until it is brought into action by contact with ingredients of the emulsion. The substance principally employed for this preservative purpose is sodium sulphite.

An over-active developer, taking into consideration also the nature of many emulsions, is liable to deposit grey metallic silver even where no light-action has taken place. This deposit is one form of what is called "fog," and is partly prevented automatically by an ingredient, potassium bromide, of the emulsion. Some of this potassium bromide dissolves into the developer, and has a "retarding" action upon formation of this fog, as well as upon the speed of development, but this amount of absorbed potassium bromide is not quite sufficient to prevent fog entirely. A small quantity is therefore added to the developer.

Proper 'Balance' Necessary. It will be obvious that if there is too much "accelerator" or too little preservative in a solution the active agent will rapidly oxidize and lose its power of developing. If there is too much preservative, or too much "retarder," it will work very slowly or not at all. Thus, a developer may be regarded as a carefully balanced and reasonably stable compound, whose balance and stability in solution are ready to be upset, and necessarily are upset, in the act of performing its function. In actual fact, its balance is upset to a considerably greater extent by reason of what it absorbs from the gelatine emulsion than by the slight loss of active content which has been used in developing the image ; and it loses still more by continuing action of the oxidation that has been set up. Thus, a quantity of solution which has developed an image may in some circumstances be used again immediately without any loss, except that of a little extra time necessitated by the extra potassium bromide "retarder" which has been absorbed from the emulsion it has worked upon.



PREPARING THE DEVELOPER. Top row, left, method of compounding amidol by measuring with minim and 2 oz. measures. Centre, lead weights and glass measure prepared for accurately repeating formula without recalculation. Right, folding paper scoop for use on scales. Bottom row, left, completing paper scoop. Centre, scoops with chemicals after weighing. Note that scoop must be added to weight side for correct measurement. Right, how to prevent bottle cracking when filling with hot solution

Photos, David Charles, F.R.P.S.

But the same solution used again the next day may have little developing power.

Fresh Solutions the Best. These facts are stated for the purpose of demonstrating that a photographic developer cannot be likened to a hammer which strikes a blow and is then ready at any time to strike as many more blows as may be desired at any time; but is much more likened to a razor-blade, which is slightly blunted by the first use, and a second use of which requires more care and gives slightly less satisfaction, whilst at a third attempt at use, or from the least lack of care in storage, it will prove to be entirely useless.

It is true that research has provided formulae for developers which act consistently on a mass of work over a long period, but these are devised specially for those who develop vast quantities of negatives daily in tanks holding ten gallons or more of solution apiece. On the other hand, there is little doubt that freshly prepared solution produces the best consistent results from exposures which tend, as most "instantaneous" ones do, towards inclusion of dim, under-exposed detail. So that the amateur photographer, or the comparatively small professional, is not really at a disadvantage. In fact, he has the superlative advantage that he can employ fresh developer of a kind, or of a concentration, suited to any particular type of work he may handle.

Varying Characteristics. Although it may rightly be said that almost any developer can be used to develop any type of

emulsion, or for any type of subject, yet some varieties have peculiar characteristics which render one more suitable than others for specific purposes. Again, such characteristics may be either exaggerated or modified to behave more like other varieties by making alterations in the proportions of the ingredients, and particularly in the proportions of the water (the concentration), and of the potassium bromide content. Such modifications are described in sections dealing with definite applications. Here it is proposed to discuss in detail the normal characteristics of the best-known developers.

Various 'Agents' Described. These various characteristics are considered as regards the type and colour of the image which they deposit from the latent image, the speed with which they act, and the degree to which their behaviour is affected by temperature and in some cases by addition of extra potassium bromide; the degree of microscopic granularity of the silver image produced is an important characteristic, even the *raison d'être*, of some developers.

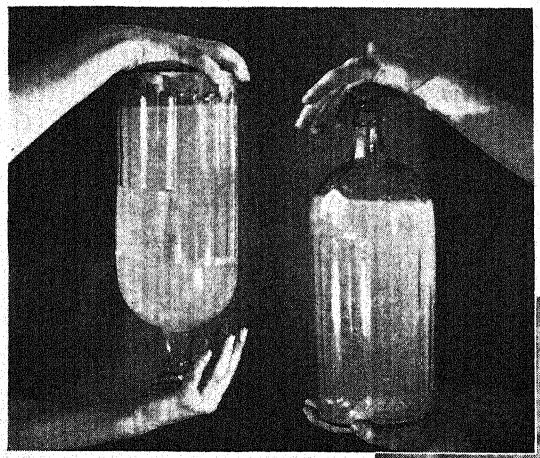
It is the presence or absence of these characteristics in varying degrees which renders a particular agent or a particular method of using it more suitable for certain purposes.

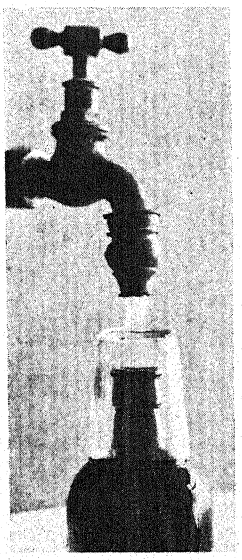
Adurol. Trade name of an agent manufactured by Messrs. Johnson & Sons, Ltd., similar to chlorquinol (*see below*).

Amidol. This agent requires no alkali, and among general-purpose developers is practically alone in that respect. It is compounded with sodium sulphite, and usually also a small proportion of potassium bromide. It is a favourite developer for bromide paper, for which purpose a simply memorized formula, which gives a rich black colour, is as follows:

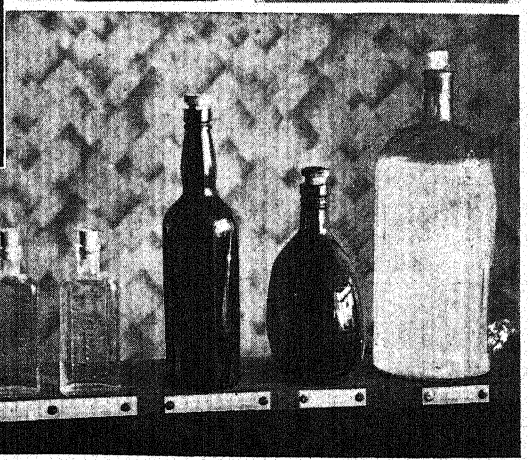
Sodium sulphite	1 oz.
Amidol	1 dr.
Water	1 pint
Potassium bromide 10 per cent. solution ..	1 minim per ounce

One advantage of memorizing this formula is occasioned by the fact that amidol will not keep in solution, and should be made up not longer than one day before use. Amidol can be used for almost any variety of sensitive emulsion, including gaslight paper,









HINTS FOR HANDLING. *Above*, inverting the bottle containing the solution ensures homogeneity without introducing air after adding making-up water and bromide *Centre*, how to secure rapid cooling of a bottle containing warm solution. *Upper right*, leaving the stopper out of the bottle until the latter has cooled prevents the former sticking when replaced. Vaseline should not be used. *Lower right*, to avoid mistakes chemicals should be kept in a selection of bottles of differing shapes and sizes with labels fixed to the shelf

Photos, David Charles, F.R.P.S.

and is cheap, but tests have shown that as regards work done for money expended it is not superior to metol-hydroquinone (*see below*). Amidol is liable to stain badly the finger-nails of those who employ it regularly. Amidol gives a delicate greyish image on negative material unless development is prolonged or a strong solution is used, but it is favoured as a developer in hot climates. This is because the absence of an alkali helps to keep down softening and loosening from its support of the gelatine emulsion.

Athenon. A pure form of glycin (*see below*) manufactured and sold by the Eastman Kodak Company in America. (*See also* Kodurol.)

Azol. A concentrated single-solution developer made by Messrs. Johnson & Sons, Ltd. (*See* Paraminophenol.)

Certinal. *See* Paraminophenol.

Chlorquinol. An agent manufactured by Messrs. Johnson & Sons, Ltd. The makers claim that it has similar working properties to hydroquinone (*see below*), but that it is less liable to be adversely affected by variations of temperature. The principal use of chlorquinol, however, is for the development of warm-tone chloro-bromide papers and lantern plates. The proportions of a chlorquinol developer may be varied, especially by increases of potassium bromide, with corresponding increases of exposure to produce warmer tones.

Dolmi. The Eastman Kodak equivalent of amidol (*see above*).

Eikonogen. An agent consisting of small yellowish crystals. Being difficult of solution in cold water, warm should be used for compounding this developer. It is not in very general use in this country, but is remarkable for its freedom from tendency either to fog or stain production. Negatives developed with it are thin, with clear, delicate detail. It is claimed for Eikonogen that a solution which has completely darkened with age will develop satisfactorily.

Elon. The Eastman Kodak equivalent of metol (*see below*).

Ferrous-Oxalate. This is an "iron" developer. When bromide paper was first produced it was the only developer available for it. It requires an acid stop-bath intermediately between development and fixing, and usually needs more exposure than more modern developers. Ferrous-oxalate is still in daily use for the development of wet-collodion negatives in the making of process blocks.

Instructions for its composition (from the "British Journal Photographic Almanack") are as follows :

A.

Potassium oxalate (neutral)	5 ozs.
Hot water	20 ozs.

Cool, and pour off liquid.

B.

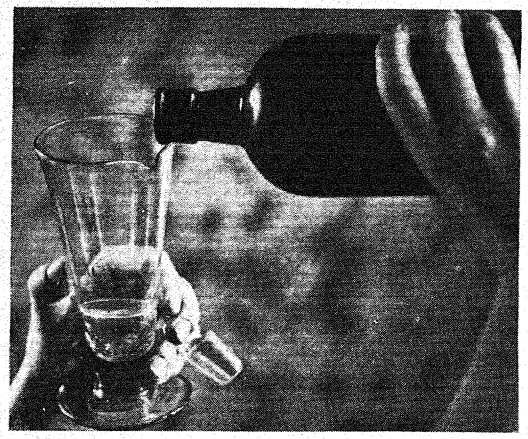
Warm water	20 ozs.
Sulphuric acid	30 minims
Ferrous sulphate (sulphate of iron) ..	5 ozs.

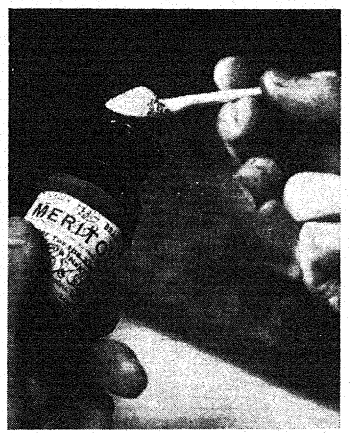
Mix 1 oz. of B with 3 to 4 ozs. of A, pouring B into A.

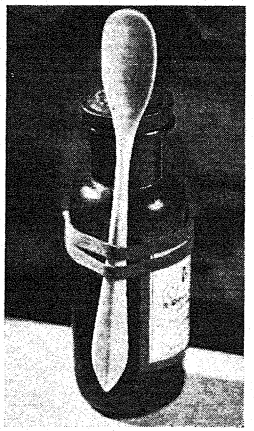
Glycin. An early but for long a much-neglected agent, which of recent years has come into considerable prominence, first for the development of warm-tone chloro-bromide papers, and now for miniature films on account of its fine-grain development properties. It is a product variable as to quality for these purposes. For this reason manufacturers select samples which comply with stringent tests and market these under specific trade names. (*See* Athenon *and* Kodurol.)

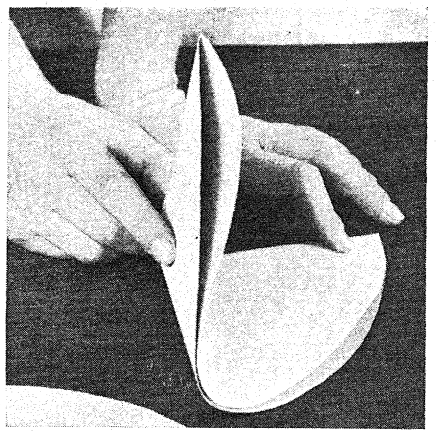
A peculiarity of glycin is that it may not completely dissolve in the water of a solution until most of the alkali has been incorporated, but it is essential to dissolve some of the sodium sulphite (preservative) first. Glycin is particularly free from liability to stain or fog, and its fine-grain characteristic is increased by combining with paraphenylene-diamine (*see below*).

Hydroquinone. Sometimes called hydrokinone or quinol. Hence the familiar abbreviation "M.Q." for the deservedly popular combination with metol (*see below*) as a "universal" developer for both negatives and positives of all kinds. Hydroquinone used as the sole agent in a formula has definite characteristics by which it stands practically alone for certain purposes. For instance, when compounded with the usual sodium sulphite and sodium carbonate ingredients, but more especially when sodium or potassium hydrate (caustic soda or potash) replaces the sodium carbonate ingredient, hydroquinone is remarkable for the extreme density and blackness of the silver deposit it produces. For this reason it is by far the

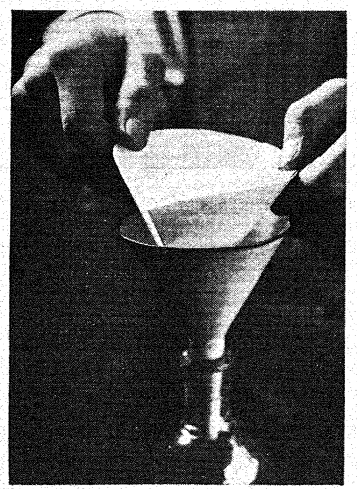


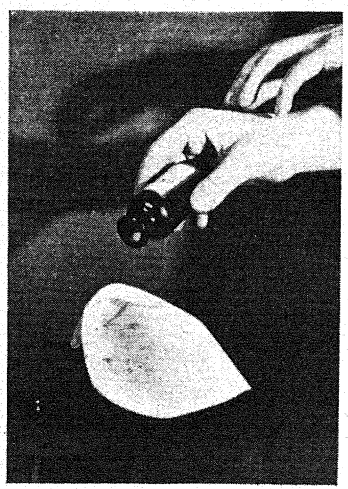


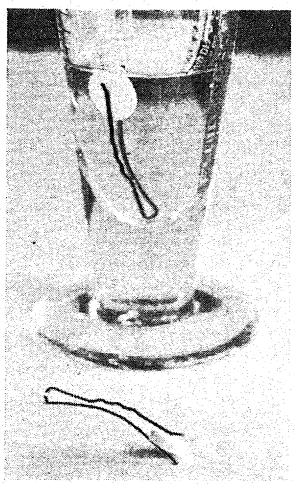


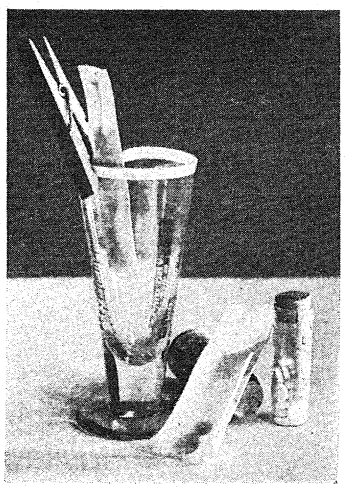


DETAIL AIDS IN MAKING DEVELOPER. *Sundry useful hints which simplify the work of making up developer solutions are illustrated in this series of explanatory photographs.* Left to right these are (1) How to hold the stopper or cork when measuring out a liquid ; the stopper should not be placed on the bench ; (2) A bone mustard spoon, filed narrow, can be used for extracting small quantities of powders from narrow-necked bottles ; (3) The spoon fixed to the bottle by a rubber band to keep it clean ; (4) Folding filter paper for funnel









FURTHER HINTS ILLUSTRATED. Left to right : (5) How the filter paper is opened for use into the funnel ; (6) Extracting small quantities of powder by tapping the bottle ; (7) and (8) Ensuring complete solution of tablets. The tablet is held in an inverted clip, or a fold of filter paper containing the tablets is clipped to the rim of the measure

Photos, David Charles, F.R.P.S.

best developer for making line negatives on either process or other plates, or for any other purpose in which maximum contrast is required.

It has, however, three other characteristics which sometimes appear to counteract this advantage, and may give rise to disappointment unless they are known and guarded against. In the first place hydroquinone acts more slowly than many other agents, and extra potassium bromide slows it more still, while unless allowed to act to completion, or nearly so, its density characteristic is not attained. Therefore, for maximum density development must be fully timed.

The second, but most important characteristic of hydroquinone is that it is of all agents the most susceptible to be affected by temperature. At the fairly normal temperature of 60° F. it works quite feebly, and at 58° F. it practically stops working altogether. A drop in temperature from the usual region of between 65° and 68° F. (at which most developers work best) may be ruinous to satisfactory results with hydroquinone.

The third characteristic which, however, will not show itself under proper conditions, is a tendency to producing a stain of exceptionally virulent nature, and one which is difficult, or impossible, to remove.

A comparatively frequent form of the stain occurs in negatives developed in hydroquinone. This developer is not rapidly removed from the gelatine by ordinary rinsing with very cold water, but if it is not well rinsed out the hydroquinone remaining in the film of a negative may oxidize rapidly if, before fixation is complete, it is exposed unduly to air or to the accumulation of alkali, etc., in a much-used fixing-bath. It is in the clear undeveloped portions of a negative that most active hydroquinone remains, and it is in those portions that a strong brown stain may occur if conditions are favourable to its formation. Such a stain is in the form of a partial positive which " cancels out " the negative image. This stain is sometimes iridescent by reflected light, and is liable to be mistaken for staleness of material or " chemical fog " (*see* Fog).

A desirable precaution when compounding hydroquinone with caustic alkali is to avoid handling the latter with bare fingers, which especially the stick form of potassium hydrate tempts one to do. Hydroquinone has a tanning, or toughening, effect on the gelatine emulsion, but less so than pyro (*q.v.*).

Kodurol. Trade name for glycin sold by the Kodak Company.

Meritol. An agent manufactured by Messrs. Johnson and Sons, Ltd., especially for fine-grain development in a tank of miniature negatives. It works slowly and the colour of the image when viewed by reflection is different from that seen when looking through it. Positive plates (*e.g.* lantern slides) developed in Meritol have a very clear, warm-toned image.

Metol. An agent which can be used alone or in combination with other agents. It is of the class of agents which produce a faint image of the whole picture rapidly, while attaining full density of the more exposed portions very gradually. Used in this way it has the characteristic of producing a pure grey image at any stage of development, and consequently is very useful for ensuring a good colour upon positive images which are required not to be developed to completion.

By far the most general use of metol is in combination with hydroquinone in the series of formulae known as " M.Q." The soft-working characteristic of the metol constituent is balanced in them by the contrasty characteristic of hydroquinone, and a harmoniously working developer of considerable production capacity results. This mixture has the outstanding advantage that it is amenable to a number of different purposes by varying the concentration (water content) alone.

A fairly strong solution, as used for gaslight paper (*q.v.*) but especially with the addition of one or two drops per ounce of 10 per cent. potassium bromide solution, is capable not only of producing images of greater contrast than one of normal strength, but will even develop perfect line negatives under anything but extremely adverse conditions of material or original. On the other hand the same formula may be used in dilute form (adding water only) for producing delicate grey prints or lantern slides, or for tank development of negatives (*see* Tank Development).

" M.Q." (prominently among other compounded developers) is readily obtainable practically anywhere in the world in various

ready-for-use forms. These include packeted powders, the same prepared for a specific tank capacity, a single-solution form, and also compressed tablets. The mixed powders can also be obtained in bulk for making quantities from one gallon to forty gallons. All these forms require no weighing.

Another important combination of metol is that with pyro (*see* Pyrogallic Acid *below*), especially useful for the development of under-exposed sports subjects.

A characteristic of metol is its liability to refuse to dissolve in a strong solution of sodium sulphite, and even if solution is apparently accomplished it may crystallize out of such a solution on cooling. In the latter event redissolving becomes extremely difficult. For these reasons it is usually recommended that metol should be dissolved in the water before any other ingredient. If, however, good keeping of the solution is desired, it is by far the superior method to dissolve a very small quantity of the sodium sulphite preservative first, to prevent the initial tendency towards oxidization, which has an inevitable continuing action, of an agent dissolved without preservative. Some samples of metol effervesce when dissolved in very hot water. The writer has been unable to obtain from manufacturers any explanation or opinion as to any adverse consequences arising from this.

Paraminophenol. Formerly improperly described as para-amidophenol. This particular agent is rarely used by those who make up their own solutions, partly because the compounding requires some little special knowledge and skill. The principal advantage of this developer is that it can be prepared in unusually concentrated form, and that in that form it has quite remarkable keeping properties. Even when the strong stock solution has turned to a dark colour through extreme age, it is reputed to work quite satisfactorily. The characteristic image is one which inclines to delicacy rather than contrast, and except when used in strong solution development is gradual. The commercially prepared formulae of paraminophenol are sold under the names Azol, Certinal, and Rodinal.

Paraphenylene-Diamine. An agent which, compounded with sodium sulphite only, gives negatives of the very finest grain, and its greatest importance is to miniature camera users and cinematographers. This agent has to be dissolved in quite hot water of approximately 160° F., and the sodium sulphite is added afterwards. It is a very slow-acting developer, and is of real interest only to those workers who enlarge to more than seven or eight diameters, and whose subjects permit of increasing the exposures normally given by at least twice or three times.

For the last-named reason it is usual to make a compromise between exposure-increase and maximum fineness of grain by making combinations of paraphenylene-diamine with glycin or other more active agents. This agent is particularly liable to stain articles upon which solution may be spilt. (*See also* Fine-Grain Developers, pages 540 and 543; *also* Fine-Grain Development for Miniature Films under the heading Developing, page 568.)

Pyrocatechin. Apparently a little-used developing agent. According to the alkali with which it is compounded, it may be made up into either a slow-working developer for delicate negative images, or an energetic one for known under-exposures such as those on speed subjects and the like. It possesses the advantages of being not very sensitive to changes in temperature, and of keeping well in solution.

Pyrogallic Acid. "Pyro," to give this agent its familiar abbreviation, was originally made from gall nuts, and was the first developing agent to replace iron salts in the development of silver images.

Some of the claims for its superiority over later introductions include that it gives better tone-gradation in reproducing the scale of tones in the subject photographed; that it is less liable than any other agent to be affected by changes in temperature; that it is more amenable than others to various purposes by addition of varying proportions of water or of potassium bromide.

What is undoubtedly true about pyro developer is that it has a characteristic yellow stain, but that the proportion or strength of this stain follows precisely the varying densities of the image, and thus virtually intensifies its printing density. Although pyro developer can be compounded so that little or no stain results, there is no doubt about its liability to stain the finger-nails irremediably, and almost any other organic

substance with which spilt solution comes into contact. Probably the most useful application of pyro is its combination with metol in the formula known as pyro-metol.

This has the rapid energy characteristic of metol, together with a considerably increased tendency to produce a yellow stain-image. Thus a pyro-metol developer is the one *par excellence* for obtaining a negative of possible printing strength from such exposures as in any other formula would be merely a barely visible grey. The press-photographer who takes high-speed photographs of football matches late on dull November afternoons has cause to bless the characteristics exclusively belonging to pyro-metol.

A characteristic of pyrogallic acid in use is that it is extremely liable, in dish development, to a reticulation marking (not physical reticulation of the gelatine, which is an entirely different trouble). For this reason the dish must be continuously, but *gently*, rocked during development when using a " straight " pyro or pyro-metol developer. Pyro " tans " and toughens the gelatine emulsion considerably more than other developers.

Rodinal. *See* Paraminophenol.

Rytol. Trade name for a developer put up in tabloids (compressed tablets) by Messrs. Burroughs Wellcome & Co., Ltd.

Supramin. One of many proprietary brands of fine-grain developer marketed under trade names descriptive of their application to miniature film negatives.

Vedol. A compressed tablet developer produced by Messrs. Johnson & Sons, Ltd.

Making up Developer Solutions. For immediate use, and for comparatively unimportant purposes, there is nothing more to be done than to dissolve the ingredients in the required quantity of any water which may be at hand. But where the quality and character of the results are a matter of concern, where good keeping of the solution over a period is required, and especially in the case of certain readily oxidized agents, both the character of the water used for solution and the actual manipulation of the process of mixing assume considerable importance.

It is noteworthy that in the hands of two different workers, both employing ostensibly the same methods, the same formula will sometimes behave differently. One difference will be observable in regard to the period during which the solution will remain clear and good before or during use ; another difference will be seen in the character of the resulting images. In fact, it is quite a frequent experience among those whose work involves the tracing of other people's technical troubles to find that weakness of negative images attributed by their producer to fault in the batch of material, by reason of comparison with others previously developed in solution from the same bottle, is due only to rapid deterioration of the stock solution.

The Best Conditions for Compounding. Thus we find certain conditions which are favourable or unfavourable to the efficient compounding of developers in general. We find also certain agents which are peculiarly prone to be affected by adverse conditions ; and finally we find certain agents whose natural peculiarities call for specific modifications in the procedure.

To take the general conditions first, it will be readily understood that anything which will introduce air into a developing solution must tend to oxidize the principal ingredient and thus diminish its active properties. Once this evil influence commences in a solution it has a continuing action in the same direction. Now practically all water contains some air in suspension. Distilled water, often recommended on account of purity for compounding developers for fine-grain work and the like precise purposes, contains considerable quantities of air. In fact, its air-content is probably far more harmful against good-keeping properties than the lime and other ingredients of " natural " water.

The thing, then, is to remove the suspended air from water, and to prevent fresh air from being dissolved in the course of making up the solution. The first condition is achieved by the simple plan of boiling the water. If water is boiled, multitudes of air-bubbles appear, as though from nowhere. This is the air, which rises to the surface on application of heat. After a time the water ceases bubbling and merely " heaves " ; it has then little air left in it. Incidentally, the process of boiling usually removes, or rather precipitates, also most of the lime and other natural contents. These

usually settle at the bottom of a bottle of solution, which the precise may feel inclined to decant or filter.

To prevent more air from being admixed, all that is required is to avoid violence in stirring the ingredients when making solution. To introduce the chemicals into a bottle of plain water fresh from the tap and then to shake vigorously is now seen in its true light of being precisely the very worst procedure possible, as regards efficient working and keeping of the resultant solution. Even worse foes than air, not from the aspect of good keeping, but as regards good working qualities, are grease and hypo. Almost microscopic quantities of either may cause havoc upon negatives.

The above remark is inspired by actual cases of troubles, the causes of which the writer has been called upon to ferret out. Domestic vessels are often requisitioned for the mixing of solutions, but it is no infrequent thing to discover, very slight, but photographically serious traces of grease left in a jug from the last " washing-up," since household cleanliness is regarded more from an optical than a chemical point of view. In much the same way a cracked earthenware jug was discovered to be the cause of serious chemical contamination. The glaze on such vessels is a surface one only, the inner material being extremely porous. Hence solutions such as those of hypo are readily absorbed into the walls of a cracked vessel, and are by no means removed by ordinary rinsing; but the next solution compounded in such a vessel is sure to be contaminated. Many mysterious troubles are traceable to such origins.

There is nothing better than a sound earthenware jug in which to mix chemicals. The exposed iron of an imperfect enamel jug does little harm, if any, to a developer, but it may cause trouble with some other chemicals. Inert substances for mixing vessels and for stirring implements are stainless steel, china-ware, glass, ebonite and silver. Brass or zinc (" galvanized " iron is coated with zinc) should definitely be avoided.

Readily Oxidized Agents. Hydroquinone and pyro are the agents which are more prone than most others to be adversely affected by neglect of the above precautions. The result in the case of hydroquinone is probably the more dangerous, since its effects, in the form of brown stain, are more often seen in what should be the clear parts of a negative (*see* Hydroquinone *above*). In the case of pyro the result of neglect usually is to increase the yellowness of the actual image, and so to produce negatives of far more effective contrast than their appearance conveys. The increase of yellowness is rapidly progressive with the age of an improperly prepared solution. But this disadvantage may be turned to good account in the case of developing exposures of extreme under-exposure with a pyro-metol formula (*q.v.*) in which a freshly prepared solution purposely compounded with a minimum of both " preservative " content and of anti-oxidization precautions will often work wonders. The stain-image, then, may be several times the printing value of the actual silver image.

Special Precautions. The order in which ingredients are dissolved has often considerable bearing upon the good-keeping qualities of a developing solution. The maker's directions should be studied, in conjunction with the special notes given above, both under general recommendations and in regard to special characteristics of individual agents.

Certain agents refuse to dissolve readily in the presence of other ingredients, and therefore should be dissolved in the water first. Obviously the preservative in such cases should follow them into the water with as slight intermission as possible. Among these are metol, Elon, and paraphenylene-diamine. A special recommendation is made in regard to the first-named (*q.v.*). Others require very hot water, as specified under individual descriptions, but it should be remembered that sodium sulphite often refuses to dissolve completely until the temperature has gone down somewhat. Patience, rather than energy, is thus indicated. Since manufacturers issue specific details of special methods which may be required with each bottle of peculiarly behaving agents, it will be unnecessary to amplify this point further.

Mixed Developers. " Mixed " formulae having two or more agents are frequently recommended for special purposes, in addition to those already described above, namely, metol and hydroquinone, pyro and metol, paraphenylene-diamine and glycin.

DEVELOPERS: CHART OF FORM

AGFA NEGATIVE DEVELOPERS

(1) Agfa 14 (Fine-Grain Developer)

Water	20 oz.	(1,000 c.c.)
Metol	40 grs.	(4 5 grm)
Sodium sulphite (anhydrous)	745 grs.	(85 grm.)
Sodium carbonate (anhydrous) ...	9 grs.	(1 grm.)
Potassium bromide	4½ grs.	(0.5 grm.)

If crystallized sulphite and carbonate are preferred the quantities are 170 grm. or 1,500 grs. for the sulphite, and 2 7 grm. or 25 grs. for the carbonate.

This developer is soft working, and tends to compensate for over-exposure. When it becomes slow in action it can be regenerated by adding 0.7 grm. or 6½ grs. of anhydrous carbonate. This may be done two or three times before the developer is exhausted.

(2) Agfa 15

Water	20 oz.	(1,000 c.c.)
Metol	70 grs.	(8 grm.)
Sodium sulphite (anhydrous)	1,100 grs.	(125 grm.)
Sodium carbonate (anhydrous) ...	105 grs.	(12 grm.)
Potassium bromide	15 grs.	(1.5 grm.)

If crystallized sulphite is used, take 250 grm. or 2,200 grs. If crystallized carbonate is used, take 32 grm. or 280 grs.

This developer is considerably more contrasty than the preceding.

(3) Agfa DS15 (Desensitizing)

To each litre of Agfa 15, add 30 c.c of pinacryptol green, 1:500 solution. Or to each pint of Agfa 15 add 290 minims.

Even with the fastest panchromatic films, an indirect red light may be used after four minutes' development.

(4) Agfa 16 (for high temperatures)

Water	20 oz.	(1,000 c.c.)
Metol	53 grs.	(6 grm.)
Sodium sulphite (anhydrous) ...	880 grs.	(100 grm.)
Sodium carbonate (anhydrous) ...	105 grs.	(12 grm.)
Potassium bromide	25 grs.	(3 grm.)

If crystallized sulphite is used, take 200 grm. or 1,760 grs. If crystallized carbonate is used, take 32.5 grm. or 283 grs.

For development at temperatures up to 86 degrees Fahr. After development, rinse for 40 sec. and transfer to an acid hardening fixer.

Times of Development

For 35-mm. Film

In Agfa 14, give Isopan FF 5—7 minutes, Isochrom F and Isopan F 7—9 minutes, and I.S.S. 10 to 12 minutes at 65 degrees Fahr.

In Agfa 15, develop for 6—8 minutes at 65 degrees Fahr.

In Agfa DS15, develop I.S.S. films for 8—10 minutes at 65 degrees Fahr.

For Roll Films.

In Agfa 16 develop Isopan or I.S.S. films 2—4 minutes at temperatures up to 86 degrees Fahr.

BARNET NEGATIVE DEVELOPERS

(5) Barnet Standard Pyro-Soda

Pyro Stock Solution:

Potassium metabisulphite	100 grs.	(28 grm.)
Pyrogallol	440 grs.	(125 grm.)
Potassium bromide	60 grs.	(17 grm.)
Water to	8 oz.	(1,000 c.c.)

No. 1 Solution:

Stock pyro	2 oz.	(50 c.c.)
Water up to	20 oz.	(500 c.c.)

No. 2 Solution:

Sodium carbonate (anhydrous) ...	360 grs.	(20 grm.)
Sodium sulphite (anhydrous)	540 grs.	(31 grm.)
Water to	20 oz.	(500 c.c.)

If crystallized salts are used, take 880 grs. (50 grm.) of carbonate and 990 grs. (62 grm.) of sulphite.

For use, take equal parts of No. 1 and No. 2. For over-exposed plates, use more of No. 1, and add a few drops of 10 per cent solution of potassium bromide. For under-exposures use more of No. 2.

This developer is standard for all Barnet plates except Process, Line-Tone Process, and Line-Tone Panchromatic Process.

(6) Barnet Hydroquinone-Caustic

No. 1.

Hydroquinone ...	240 grs.	(27 grm.)
Potassium metabisulphite	240 grs.	(27 grm.)
Potassium bromide	240 grs.	(27 grm.)
Water to	20 oz.	(1,000 c.c.)

No. 2.

Pot. hydroxide ...	440 grs.	(50 grm.)
Water to	20 oz.	(1,000 c.c.)

For use mix equal parts of No. 1 and No. 2.

This developer is recommended for Rapid Panchromatic Process, Line-Tone Process, and Line-Tone Panchromatic Process plates.

(7) Developer for Barnet Process Plates

No. 1.

Hydroquinone ...	120 grs.	(13.5 grm.)
Sodium sulphite (anhydrous)	180 grs.	(20 grm.)
Potassium bromide	20 grs.	(2.2 grm.)
Water to	20 oz.	(1,000 c.c.)

No. 2.

Pot. carbonate ...	880 grs.	(100 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, double the above quantity.

For use, take equal parts of No. 1 and No. 2.

(8) Barnet M.Q. Developer. Form A

Metol	17.5 grs.	(2 grm.)
Sodium sulphite (anhydrous)	450 grs.	(50 grm.)
Hydroquinone ...	52.5 grs.	(6 grm)
Sodium carbonate (anhydrous) ...	245 grs.	(28 grm.)
Potassium bromide	10 grs.	(1 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 900 grs. (100 grm.). If crystallized carbonate is used, take 660 grs. (75 grm.)

For use take equal parts of developer and water.

(9) Barnet M.Q. Developer. Form B

Metol	45 grs.	(5 grm.)
Hydroquinone ...	45 grs.	(5 grm.)
Sodium sulphite (anhydrous)	250 grs.	(28 grm.)
Sodium carbonate (anhydrous) ...	185 grs.	(21 grm.)
Potassium bromide	25 grs.	(3 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take 500 grs. (55 grm.) of each.

(10) Barnet M.Q. Developer. Form C

Metol	12½ grs.	(1.5 grm.)
Hydroquinone ...	35 grs.	(4 grm.)
Sodium sulphite (anhydrous)	240 grs.	(27.5 grm.)
Sodium carbonate (anhydrous) ...	180 grs.	(20 grm)
Potassium bromide, 10 p.c. solution ...	60 min.	(6 c.c.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take of each 440 grs. or 50 grm.

Formula A is recommended for the following plates: Ultra-Sensitive Pan., Super-Fixer Press, Super-Press, Super-Iso, XL Super-Speed Ortho, and Ordinary.

Formula B is recommended for: Special Rapid, Press-Ortho, Super-Speed Ortho, Self-Screen Ortho, Fine-Grain Ordinary, and Studio plates.

Formula C is recommended for Special Rapid Pan. and Soft-Studio Pan. plates.

CRITERION NEGATIVE DEVELOPERS

(11) Standard Pyro-Soda Developer

Stock Pyro:

Pyrogallol	440 grs.	(50 grm.)
Potassium metabisulphite	100 grs.	(12 grm.)
Potassium bromide	20 grs.	(2.3 grm.)
Water to	10 oz.	(500 c.c.)

Solution No. 1:

Stock Pyro solution	2 oz.	(50 c.c.)
Water to	20 oz.	(500 c.c.)

Solution No. 2:

Sodium sulphite (anhydrous)	440 grs.	(25 grm.)
Sodium carbonate (anhydrous) ...	360 grs.	(20 grm.)
Water to	20 oz.	(500 c.c.)

If crystalline salts are used, take 880 grs. (50 grm.) of each.

For development, mix equal parts of No. 1 and No. 2.

This developer is standard for all Criterion plates except Process and Press.

(12) Standard M.Q. Developer

Metol	40 grs.	(4.5 grm.)
Hydroquinone ...	40 grs.	(4.5 grm.)
Sodium sulphite (anhydrous)	360 grs.	(41 grm.)
Sodium carbonate (anhydrous) ...	270 grs.	(30 grm.)
Potassium bromide	10 grs.	(1 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystals of carbonate and sulphite are used, take 660 grs. (75 grm.) of each.

This developer is standard for all Criterion plates except Press and Process plates.

(13) Criterion M.Q. Developer for Negative Card

Metol	20 grs.	(2.2 grm.)
Hydroquinone ...	40 grs.	(4.5 grm.)
Sodium sulphite (anhydrous)	240 grs.	(27 grm.)
Sodium carbonate (anhydrous) ...	175 grs.	(20 grm.)
Potassium bromide	30 grs.	(3.4 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystals of carbonate and sulphite are used, take 440 grs. (50 grm.) of each.

(14) Criterion Press Pyro-Metol

No. 1:

Metol	40 grs.	(4.5 grm.)
Potassium metabisulphite	120 grs.	(13.5 grm.)
Pyrogallol	60 grs.	(7 grm.)
Potassium bromide	20 grs.	(2.2 grm.)
Water to	20 oz.	(1,000 c.c.)

No. 2:

Sodium carbonate (anhydrous) ...	660 grs.	(75 grm.)
Or crystals	1,760 grs.	(200 grm.)
Water to	20 oz.	(1,000 c.c.)

For use, take equal parts of No. 1 and No. 2.

Pyro-metol has a reputation for giving better results than any other developer for cases of under-exposure.

(15) M.Q. for Criterion Press Plate

Metol	20 grs.	(2.2 grm.)
Sodium sulphite (anhydrous)	220 grs.	(25 grm.)
Hydroquinone ...	40 grs.	(4.5 grm.)
Sodium carbonate (anhydrous) ...	180 grs.	(20 grm.)
Potassium bromide	10 grs.	(1 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystals of carbonate and sulphite are used, take 440 grs. (50 grm.) of each.

(16) Hydroquinone-Caustic Developer for Process Plates

No. 1:

Hydroquinone ...	240 grs.	(27 grm.)
Potassium metabisulphite	240 grs.	(27 grm.)
Potassium bromide	240 grs.	(27 grm.)
Water to	20 oz.	(1,000 c.c.)

No. 2:

Caustic potash ...	440 grs.	(50 grm.)
Water to	20 oz.	(1,000 c.c.)

For use, take equal quantities of No. 1 and No. 2. Rinse well before fixing.

GEVAERT NEGATIVE DEVELOPERS

(17) G.202. Pyro-Metol Developer

A. Metol	37 grs.	(4.2 grm.)
Potassium metabisulphite ...	90 grs.	(10 grm.)
Pyrogallol ...	90 grs.	(10 grm.)
Sodium sulphite (anhydrous) ...	440 grs.	(50 grm.)
Pot. bromide ...	9 grs.	(1 grm.)
Water to make	20 oz.	(1,000 c.c.)
B. Sodium carbonate (anhydrous)	780 grs.	(88 grm.)
Water to ...	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take respectively 880 grs. (100 grm.) and 1,940 grs. (220 grm.).

For correctly exposed negatives, take equal parts of A and B. For over-exposure, take more A; for under-exposure, more B. For softer results, dilute with 1 or 2 parts of water.

Normal development takes 5 minutes at 60—65 degrees Fahr. Suitable for negative material of every type.

(18) G.205. Metol-Pyro-Hydroquinone Stock Solution

Metol	18 grs.	(2 grm.)
Sodium sulphite (anhydrous)	600 grs.	(68 grm.)
Hydroquinone ...	74 grs.	(8.4 grm.)
Sodium carbonate (anhydrous) ...	480 grs.	(55 grm.)
Potassium metabisulphite	105 grs.	(12 grm.)
Pyrogallol	74 grs.	(8.4 grm.)
Potassium bromide	17½ grs.	(2 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 1,200 grs. (135 grm.); if crystallized carbonate is used, take 1,300 grs. (150 grm.).

For dish development, dilute 1 part of G. 205 with 4 parts of water, and develop 5 to 8 minutes at 60—65 degrees Fahr.

For tank development, dilute 1 part of G. 205 with 9 parts of water, and develop about 20 minutes at 60—65 degrees Fahr.

This formula gives vigorous and clear negatives of yellowish colour, and is suitable for negative material of every type.

(19) G. 213. Pyro-Soda (One Solution)

Pyrogallol	22 grs.	(2 5 grm.)
Potassium metabisulphite ...	22 grs.	(2.5 grm.)
Sodium sulphite (anhydrous)	90 grs.	(10 grm.)
Sodium carbonate (anhydrous) ...	45 grs.	(5 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 180 grs. (20 grm.); if crystallized carbonate is used, take 120 grs. (13.5 grm.).

This developer is recommended for portraits on Superchrom and Ultra-Panchro Studio Films.

Gives soft and well-detailed negatives in about 10 minutes at 65 degrees Fahr.

(20) Gevaert

A. Potassium bisulphite Pyrogallol Sodium (anhydr Pot. brom Water (bo distilled)

B. Sodium ate (anh; Water (bo distilled)

If crystalliz. 960 grs. (110 bonate is used, For normal of A and B, more of A. U

(21) Gevaert

Metol ... Hydroquinone Sodium sulph hydrous) Sodium ca (anhydrous) Potassium Water to m

If crystalliz 600 grs. (68 bonate is used Recommende

(22) Gevaert

A. Metol Hydroquin Sodium (anhydr Pot. bron Water (b distilled

B. Sodium ate (anh Water (1 distilled

If crystalli 1,200 grs. (1 bonate is use For normal A and B. F and 1 part B A, 1 part B; Recommend

(23) G. 201.

Metol ... Sodium sulp hydrous) Hydroquino Sodium c (anhydrou Potassium Water to m

If crystall 960 grs. (1 bonate is us This develo about 5 min

(24) G. 212. Plates

Metol Sodium sul hydrous) Hydroquino Sodium (anhydro Potassium Water to

If crystal 960 grs. (1 bonate is us Time of 60—65 degr

(25) G. 214. Plates

Metol ... Sodium sul hydrous) Hydroquin Sodium (anhydro Potassium Water to

If crystal 480 grs. (1 bonate is u

(26) G. 204

Sodium su hydrous) Glycin ... Pot. carb Methyl al Water to

If crysta 300 grs. (3 For dish develop for Fahr. 3 4 m ro

To face page 536

ULAE PREPARED BY LEADING MANUFACTURERS FOR 03

Compiled by A. L. M. Sowerby, of "THE AMATEUR PHOTOGRAPHER" Editorial Staff

Pyro-Soda (Two Solution)

meta-		
...	20 grs.	(2.3 grm.)
...	120 grs.	(13.5 grm.)
sulphite		
ous) ...	480 grs.	(55 grm.)
ide ...	10 grs.	(1 grm.)
iled or		
to ...	20 oz.	(1,000 c.c.)
carbon-		
drous)	355 grs.	(40 grm.)
iled or		
to ...	20 oz.	(1,000 c.c.)

ed sulphite is used, take grm.); if crystallized car- take 960 grs. (110 grm.). exposures, take equal parts For over-exposure, take nder-exposure, more of B.

M.Q. (One Solution)

... ...	17 grs.	(1.9 grm.)
...	85 grs.	(9.7 grm.)
ite (an-		
... ...	300 grs.	(34 grm.)
rbonate		
...	355 grs.	(40 grm.)
bromide	17 grs.	(1.9 grm.)
ake ...	20 oz.	(1,000 c.c.)

ed sulphite is used, take grm.); if crystallized car- take 960 grs. (110 grm.). l for Gevaert plates.

M.Q. (Two Solution)

... ...	50 grs.	(5.7 grm.)
none ...	75 grs.	(8.5 grm.)
sulphite		
ous) ...	600 grs.	(68 grm.)
nide ...	20 grs.	(2.3 grm.)
oiled or		
) to ...	20 oz.	(1,000 c.c.)
carbon-		
ydrous)	355 grs.	(40 grm.)
oiled or		
) to ...	20 oz.	(1,000 c.c.)

zed sulphite is used, take 35 grm.); if crystallized car- d, take 960 grs. (110 grm.). exposure, take equal parts or over-exposure, 2 parts A . For under-exposure, 1 part and 1 part water. d for Gevaert plates.

M.Q. Developer for Plates

... ...	14 grs.	(1.6 grm.)
hite (an-		
... ...	480 grs.	(55 grm.)
de ...	54 grs.	(6 grm.)
arbonate		
s) ...	315 grs.	(36 grm.)
bromide	17½ grs.	(2 grm.)
make ...	20 oz.	(1,000 c.c.)

ized sulphite is used, take 0 grm.); if crystallized car- d, take 850 grs. (96 grm.). per gives vigorous results in utes at 60—65 degrees Fahr.

Soft-Gradation M.Q. for

... ...	18 grs.	(2 grm.)
phite (an-		
... ...	120 grs.	(13.5 grm.)
ne ...	14 grs.	(1.6 grm.)
carbonate		
rs) ...	300 grs.	(34 grm.)
bromide	4½ grs.	(0.5 grm.)
make ...	20 oz.	(1,000 c.c.)

ized sulphite is used, take 10 grm.); if crystallized car- ed, take 810 grs. (92 grm.). development, 5 minutes at es Fahr.

M.Q. Tank Developer (for and Studio Films)

... ...	18 grs.	(2 grm.)
phite (an-		
... ...	240 grs.	(27 grm.)
one ...	27 grs.	(3 grm.)
carbonate		
ous) ...	135 grs.	(15 grm.)
bromide	9 grs.	(1 grm.)
make ...	20 oz.	(1,000 c.c.)

lized sulphite is used, take 5 grm.); if crystallized car- ed, take 360 grs. (41 grm.).

. Glycin Developer

lphite (an-		
... ...	150 grs.	(17 grm.)
... ...	90 grs.	(10 grm.)
nate ...	520 grs.	(59 grm.)
hol ...	90 mins.	(9.4 c.c.)
ake ...	20 oz.	(1,000 c.c.)

ed sulphite is used, take grm.). velopment, use undiluted and 10 minutes at 60—65 degrees nk development, dilute with water, and develop for 35 to at 60—65 degrees Fahr. oper, which gives clear, well- gatives, is recommended for c films.

(27) G. 203. M.Q. for Films of all types

Metol	4½ grs.	(0.5 grm.)
Sodium sulphite (an- hydrous)	480 grs.	(55 grm.)
Hydroquinone ...	45 grs.	(5.1 grm.)
Sodium carbonate (anhydrous) ...	315 grs.	(36 grm.)
Potassium bromide	17½ grs.	(2 grm.)
Citric acid	17½ grs.	(2 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 960 grs. (110 grm.); if crystallized carbonate is used, take 850 grs. (96 grm.).

Times of development: Roll films and packs, 5 to 7 minutes at 60—65 degrees Fahr.; Studio films, 6 to 8 minutes at 60—65 degrees Fahr.

(28) G. 210. M.Q. Tank Developer (for Roll and Pack Films)

Metol	6 grs	(0.68 grm.)
Sodium sulphite (an- hydrous)	180 grs.	(20 grm.)
Hydroquinone ...	15½ grs.	(1.75 grm.)
Sodium carbonate (anhydrous) ...	36 grs.	(4.1 grm.)
Potassium bromide	5 grs.	(0.5 grm.)
Sodium bisulphite ...	3½ grs.	(0.4 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 360 grs. (41 grm.); if crystallized carbonate is used, take 97 grs. (11 grm.).

Time of development, for roll and pack films, about 15—20 minutes at 62—65 degrees Fahr.

(29) G. 211. Soft-Gradation M.Q. for Studio Films

Metol	27 grs.	(3 grm.)
Sodium sulphite (an- hydrous)	360 grs.	(41 grm.)
Hydroquinone ...	27 grs.	(3 grm.)
Sodium carbonate (anhydrous) ...	390 grs.	(44 grm.)
Potassium bromide	9 grs.	(1 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 720 grs. (82 grm.); if crystallized carbonate is used, take 1,050 grs. (120 grm.).

Used undiluted, develop Superchrom or Ultra-Panchro Studio films for about 3 minutes at 60—65 degrees Fahr.

Diluted with 2 parts of water, development time is about 6 minutes at 60—65 degrees Fahr.

(30) G. 206. M.Q. Borax for Fine Grain

Metol	18 grs.	(2 grm.)
Sodium sulphite (an- hydrous)	960 grs.	(110 grm.)
Hydroquinone ...	37 grs.	(4.2 grm.)
Borax	17½ grs.	(2 grm.)
Water (boiled or distilled) to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the above quantity.

Dissolve the metol in one-fifth of the water at 120 degrees Fahr. In a second fifth of the water at 160 degrees Fahr. dissolve about a third of the sulphite first, and then the hydroquinone. Add this to the metol solution.

In two-fifths of the water, heated to 160 degrees Fahr., dissolve the rest of the sulphite and the borax, and after cooling pour this slowly and with stirring into the solution containing metol and hydroquinone. Make up immediately to full bulk with cold water.

This developer gives soft negatives of fine grain and delicate gradation.

Time of development, 8 to 10 minutes at 60—65 degrees Fahr.

(31) G. 207. Metol for Fine Grain

Metol	37 grs.	(4.2 grm.)
Sodium sulphite (an- hydrous)	960 grs.	(110 grm.)
Sodium carbonate (anhydrous) ...	45 grs.	(5.1 grm.)
Potassium bromide	17½ grs.	(2 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the above quantity; if crystallized carbonate is used, take 120 grs. (13.5 grm.).

Gives normal negatives of fine grain. Suitable for films of all types, but especially miniature and cine films.

Time of development, about 8 minutes at 60—65 degrees Fahr.

GRANVILLE NEGATIVE DEVELOPERS

(32) Pyro-Soda, for Plates and Cut Films

No. 1:		
Pyrogallol	120 grs.	(13.5 grm.)
Potassium metabi- sulphite	20 grs.	(2.3 grm.)
Potassium bromide	10 grs.	(1.1 grm.)
Water	20 oz.	(1,000 c.c.)
No. 2:		
Sodium carbonate (anhydrous) ...	355 grs.	(40 grm.)
Sodium sulphite (an- hydrous)	480 grs.	(55 grm.)
Water	20 oz.	(1,000 c.c.)

If crystallized salts are used for No. 2, take 960 grs. (110 grm.) of each.

For use, take equal parts of No. 1 and No. 2. For portrait negatives, dilute with an equal bulk of water.

(33) M.Q., for Plates and Cut Films

Metol	15 grs.	(1.7 grm.)
Hydroquinone ...	60 grs.	(6.8 grm.)
Sodium sulphite (an- hydrous)	360 grs.	(41 grm.)
Sodium carbonate (anhydrous) ...	310 grs.	(35 grm.)
Potassium bromide	15 grs.	(1.7 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are preferred, take respectively 720 grs. (82 grm.) and 840 grs. (96 grm.).

Dissolve in order given, and dilute for use with equal volume of water. Development should be complete in 2 to 2½ minutes at 65 degrees Fahr.

The above developer, which is identical with that recommended for Granville bromide papers, is obtainable in packets making 10 oz. each.

(34) M.Q., for Granville Negative Card

Metol	20 grs.	(2.3 grm.)
Hydroquinone ...	40 grs.	(4.6 grm.)
Sodium sulphite (an- hydrous)	240 grs.	(27 grm.)
Sodium carbonate (anhydrous) ...	178 grs.	(20 grm.)
Potassium bromide	30 grs.	(3.4 grm.)
Water	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take 480 grs. (55 grm.) of each.

ILFORD NEGATIVE DEVELOPERS

(35) ID—1. Standard Pyro-Soda Developer. Stock Solution

Potassium metabi- sulphite	100 grs.	(6 grm.)
Pyrogallol	440 grs.	(25 grm.)
Water up to	10 oz.	(250 c.c.)
Dissolve in order.		
A. Stock pyro solu- tion	2 oz.	(50 c.c.)
Water to make ...	20 oz.	(500 c.c.)
B. Sodium carbon- ate (anhydrous)	320 grs.	(18.5 grm.)
Sodium sulphite (anhydrous) ...	440 grs.	(25 grm.)
Potassium bromide, 10 p.c. solution ...	½ oz.	(6 c.c.)
Water to make ...	20 oz.	(500 c.c.)

If crystallized carbonate and sulphite are used, take 880 grs. (50 grm.) of each.

For dish use, take equal parts of A and B. For tank development, take 1 part stock solution, 5 parts B, and 20 parts water.

This developer is put up in "Tabloid" form by Messrs. Burroughs Wellcome & Co.

(36) ID—2. Standard M.Q. Developer

Metol	20 grs.	(2.3 grm.)
Sodium sulphite (an- hydrous)	660 grs.	(75 grm.)
Hydroquinone ...	80 grs.	(9 grm.)
Sodium carbonate (anhydrous) ...	320 grs.	(37 grm.)
Potassium bromide	20 grs.	(2 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized carbonate is used, take 880 grs. (100 grm.). If crystallized sulphite is used, take 1,320 grs. (150 grm.)

For dish use, dilute 1 part with 2 parts of water. For tank use, dilute 1 part with 5 parts of water.

Developers ID—1 and ID—2 are recommended for all Ilford and Selo plates and films. In either, develop Selo or Selochrome film for 5 minutes, Selo H.S. Pan. films for 4 minutes, and Selo F.G. Pan. film for 3½ minutes, all at 65 degrees Fahr. Double these times for tank development.

A full development table, covering Ilford plates as well as Selo films, will be found in the Ilford Manual and the Ilford Book of Formulae.

(37) ID—4. Pyro-Metol Developer

A. Metol	35 grs.	(4 grm.)
Potassium meta- bisulphite ...	100 grs.	(12 grm.)
Pyrogallol ...	100 grs.	(12 grm.)
Water to make ...	20 oz.	(1,000 c.c.)
B. Sodium carbon- ate (anhydrous)	640 grs.	(75 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized carbonate is used, take 1,760 grs. (200 grm.).

For use, mix equal parts of A and B.

This developer is exceedingly energetic, and is intended for plates that have received minimum exposure. The yellow colour often enables even very weak negatives to print satisfactorily.

(38) ID—3. Metol Developer.

Metol	50 grs.	(6 grm.)
Sodium sulphite (an- hydrous)	220 grs.	(25 grm.)
Sodium carbonate (anhydrous) ...	320 grs.	(37 grm.)
Potassium bromide	10 grs.	(1 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take respectively 440 grs. (50 grm.) and 880 grs. (100 grm.).

For use, dilute 1 part with 3 parts water.

This developer gives soft negatives with maximum shadow detail. Development is slow, but the developer may be used at less dilution if desired.

(39) ID—9. Amidol Developer

Sodium sulphite (an- hydrous)	880 grs.	(100 grm.)
Amidol	175 grs.	(20 grm.)
Potassium bromide	50 grs.	(5.7 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the above quantity.

For use, dilute with three times its volume of water. This is a good all-round negative developer, but will not keep for more than a day or two.

(40) ID—11. M.Q.-Borax Fine-Grain

Metol	20 grs.	(2.3 grm.)
Sodium sulphite (an- hydrous)	880 grs.	(100 grm.)
Hydroquinone ...	50 grs.	(5.7 grm.)
Borax	20 grs.	(2.3 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the above quantity.

This developer is especially suitable for miniature films and plates, and for cine film.

Time of development, 10 minutes and upwards according to film used.

(41) ID—13. Hydroquinone for Line Negatives

A. Hydroquinone ...	220 grs.	(25 grm.)
Potassium meta- bisulphite ...	220 grs.	(25 grm.)
Pot. bromide ...	220 grs.	(25 grm.)
Water to	20 oz.	(1,000 c.c.)
B. Potassium hy- droxide (stick)	440 grs.	(50 grm.)
Water to	20 oz.	(1,000 c.c.)

For use, take equal parts of A and B. Development should be complete in about 2 minutes.

This developer is only suitable for line work on process plates, where no intermediate tones are desired between full black and blank white.

For half-tone copying, use Formula ID—2 or ID—14.

(42) ID—35. Hydroquinone-Carbonate

A. Hydroquinone ...	330 grs.	(37.5 grm.)
Sodium sulphite (anhydrous) ...	825 grs.	(94 grm.)
Pot. bromide ...	80 grs.	(9 grm.)
Water to	20 oz.	(1,000 c.c.)
B. Pot. carbonate (anhydrous)	1,100 grs.	(125 grm.)
Water up to ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the quantity given.

For use, take equal parts of A and B.

This developer is an alternative to Formula ID—13.

(43) ID—14. M.Q. Contrast Developer

Metol	15 grs.	(1.7 grm.)
Sodium sulphite (an- hydrous)	660 grs.	(75 grm.)
Hydroquinone ...	110 grs.	(12.5 grm.)
Sodium carbonate (anhydrous) ...	320 grs.	(37 grm.)
Potassium bromide	20 grs.	(2.3 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 1,320 grs. (150 grm.). If crystallized carbonate is used, take 880 grs. (100 grm.).

This developer is suitable for use when copying photographs or similar objects on process or other slow plates.

Time of development, 2 to 4 minutes, according to contrast required.

(44) ID—15. Metol for Copy Negatives

Metol	30 grs.	(3.4 grm.)
Sodium sulphite (an- hydrous)	190 grs.	(22 grm.)
Sodium carbonate (anhydrous) ...	160 grs.	(18.5 grm.)
Potassium bromide	5 grs.	(0.5 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 380 grs. (43 grm.). If crystallized carbonate is used, take 440 grs. (50 grm.).

For use, dilute with an equal volume of water.

This is intended for use in making soft negatives or positives, or in making a new negative from an over-hard original.

Expose fully, and develop for 2 to 6 minutes, using a slow rate.

Quantities given in these formulae in avoirdupois and metric measures are not equal, but solutions made up throughout on either system have the same composi

NEGATIVE DEVELOPERS

45) ID—19. X-ray Developer

Metol	20 grs.	(2.3 grm.)
Sodium sulphite (anhydrous)	660 grs.	(75 grm.)
Hydroquinone ...	80 grs.	(9 grm.)
Sodium carbonate (anhydrous) ...	320 grs.	(37 grm.)
Potassium bromide	50 grs.	(5.5 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 320 grs. (150 grm.). If crystallized carbonate is used, take 880 grs. (100 grm.) For the development of X-ray films.

This developer can be obtained in tins ready for mixing.

KODAK NEGATIVE DEVELOPERS

(46) D.1. Three-Solution Pyro-Soda

A. Sodium bisulphite	86 grs.	(9.8 grm.)
Pyrogallol ...	525 grs.	(60 grm.)
Potassium bromide ...	10 grs.	(1.1 grm.)
Water to make ...	20 oz.	(1,000 c.c.)
B. Sodium sulphite (anhydrous) ...	920 grs.	(105 grm.)
Water to make ...	20 oz.	(1,000 c.c.)
C. Sodium carbonate (anhydrous) ...	660 grs.	(75 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take respectively 1,840 grs. (210 grm.) and 1,750 grs. (200 grm.).

Dish development.—1 part each of A, B and C, and add 7 parts of water. Develop for 5 to 7 minutes at 65 degrees Fahr.

Tank development.—1 part each of A, B and C, and add 11 parts of water. Develop for about 12 minutes at 65 degrees Fahr.

(47) D.72. Standard M.Q. Developer

Water	10 oz.	(500 c.c.)
Elon (Metol)	28 grs.	(3.2 grm.)
Sodium sulphite (anhydrous)	405 grs.	(46 grm.)
Hydroquinone ...	105 grs.	(12 grm.)
Sodium carbonate (anhydrous) ...	590 grs.	(67.5 grm.)
Potassium bromide	16 grs.	(1.8 grm.)
Water up to	20 oz.	(1,000 c.c.)

If using crystallized sulphite, take 810 grs. (92 grm.); if using crystallized carbonate, take 1,610 grs. (180 grm.).

For general use, take 1 part of above solution and 2 parts of water, and develop for 4 to 6 minutes at 65 degrees Fahr. For greater contrast, or shorter development time, the above solution can be used undiluted if preferred.

Suitable for dish development of roll and pack films.

(48) D.151. Portrait Film Developer

Elon (Metol)... ...	15 grs.	(1.7 grm)
Sodium sulphite (anhydrous)	880 grs.	(100 grm.)
Hydroquinone ...	60 grs.	(7 grm.)
Sodium carbonate (anhydrous) ...	385 grs.	(44 grm.)
Pyrogallol ...	60 grs.	(7 grm.)
Potassium bromide	7½ grs.	(0.85 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double above quantity. If crystallized carbonate is used, take 1,040 grs. (118 grm.).

For use, take 1 part of above solution and add 4 parts of water. At 65 degrees Fahr., develop S.S. Pan., Portrait Pan., Par-Speed and Commercial Ortho. cut films for 8 minutes, and S.S. Ortho. cut films for 12 minutes

(49) D.75. Vertical Tank Developer

A. Water (at 125 degrees Fahr.)	5 oz.	(125 c.c.)
Elon (Metol) ...	13 grs.	(0.75 grm.)
B. Water (at 125 degrees Fahr.)	5 oz.	(125 c.c.)
Sodium sulphite (anhydrous) ...	80 grs.	(4.5 grm.)
Sodium bisulphite	160 grs.	(9 grm.)
C. Water (at 160 degrees Fahr.)	5 oz.	(125 c.c.)
Sodium sulphite (anhydrous) ...	80 grs.	(4.5 grm.)
Hydroquinone ...	52 grs.	(3 grm.)
Pyrogallol ...	13 grs.	(0.75 grm.)
D. Water (at 125 degrees Fahr.)	5 oz.	(125 c.c.)
Sodium carbonate (anhydrous)	320 grs.	(18 grm.)

For crystallized sulphite, take 160 grs. (9 grm.) in solutions B and C. For crystallized carbonate, take 880 grs. (50 grm.) in solution D.

Pour A, B, C and D into the tank or other vessel in the order given, making sure that all solutions are cool before adding D. Finally, make up to 40 oz. (1,000 c.c.) with cold water, and use without dilution.

Develop 7 to 14 mins. at 65 degrees Fahr.

This is a favourite formula of the professional finisher, and is a long-life developer suitable for the development of roll and pack films of all types.

(50) D.153. Process Developer

A. Hydroquinone ...	220 grs.	(25 grm.)
Potassium metabisulphite ...	220 grs.	(25 grm.)
Pot. bromide ...	220 grs.	(25 grm.)
Water up to ...	20 oz.	(1,000 c.c.)
B. Caustic Potash	440 grs.	(50 grm.)
Water up to ...	20 oz.	(1,000 c.c.)

Take equal parts of A and B, and develop Kodaline film for 3 mins. at 65 degrees Fahr. The mixed developer should be thoroughly stirred before use. Rinse well before fixing.

D. 153 gives maximum contrast on Kodaline Film.

(51) D.154. Kodaline Developer

Elon (Metol)... ...	11 grs.	(1.25 grm.)
Sodium sulphite (anhydrous)	200 grs.	(22.5 grm.)
Hydroquinone ...	52 grs.	(6 grm.)
Sodium carbonate (anhydrous)	260 grs.	(30 grm.)
Potassium bromide	4½ grs.	(0.5 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 400 grs. (45 grm.). If crystallized carbonate is used, take 700 grs. (80 grm.).

Use without dilution, developing Kodaline Paper for 2 to 3 minutes, and Kodaline Film or Kodaline Wet Stripping Film for 3 to 4 minutes, all at 65 degrees Fahr.

When developing Extra-Rapid Kodaline Film for transparencies or soft continuous-tone negatives, dilute above developer with 3 times its bulk of water.

(52) D.157. Kodak Special Developer

Elon (Metol)	16 grs.	(1.8 grm.)
Sodium sulphite (anhydrous)	330 grs.	(37.5 grm.)
Hydroquinone ...	60 grs.	(6.8 grm.)
Sodium carbonate (anhydrous) ...	250 grs.	(28 grm.)
Potassium bromide	4 grs.	(0.45 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 660 grs. (75 grm.). If crystallized carbonate is used, take 660 grs. (75 grm.).

For use, dilute 1 part of above with 1 part water.

This developer is suitable for universal use with roll and pack films, plates, cut films and Kodak bromide paper.

(53) D.76. Fine-Grain Developer

Water (125 degrees Fahr.)	15 oz.	(750 c.c.)
Elon (Metol)... ...	17½ grs.	(2 grm.)
Sodium sulphite (anhydrous)	880 grs.	(100 grm.)
Hydroquinone ...	44 grs.	(5 grm.)
Borax	16 grs.	(1.8 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the quantity shown.

Dissolve in order given, and use without dilution. For tank development give 10 to 25 mins. at 65 degrees Fahr., or four-fifths this time for dish development.

Suitable for fine-grain results on all miniature and other films.

(54) D.76 A. Fine-Grain Developer for Cine Film

Water (125 degrees Fahr.)	15 oz.	(750 c.c.)
Elon (Metol)... ...	19 grs.	(2.2 grm.)
Sodium sulphite (anhydrous)	960 grs.	(110 grm.)
Hydroquinone ...	46 grs.	(5.3 grm.)
Borax	19 grs.	(2.2 grm.)
Water up to	20 oz.	(1,000 c.c.)

(55) D.76 B. Fine-Grain for Cine Film

Water (125 degrees Fahr.)	15 oz.	(750 c.c.)
Elon (Metol)... ...	25 grs.	(2.8 grm.)
Sodium sulphite (anhydrous)	960 grs.	(110 grm.)
Hydroquinone ...	25 grs.	(2.8 grm.)
Borax	19 grs.	(2.2 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the weight shown above. D. 76A gives rather more contrasty negatives than D. 76B. These two developers have been widely adopted by users of miniature cameras. Development time at 65 degrees Fahr., from 6 to 12 minutes according to film used.

MIMOSA NEGATIVE DEVELOPERS

(56) Three-Solution M.Q.

A. Metol	125 grs.	(14 grm.)
Sodium sulphite (anhydrous) ...	615 grs.	(70 grm.)
Water to make ...	20 oz.	(1,000 c.c.)
B. Sodium sulphite (anhydrous) ...	440 grs.	(50 grm.)
Hydroquinone ...	150 grs.	(17 grm.)
Water to make ...	20 oz.	(1,000 c.c.)
C. Sodium carbonate (anhydrous)	530 grs.	(60 grm.)
Or crystals	1,320 grs.	(150 grm.)
Water to make ...	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the amounts shown above.

For use, take 1 part each of A, B and C, and add 3 parts water. Add 10 per cent potassium bromide solution at the rate of 2 to 5 drops per oz. (5 to 10 c.c. per litre) of mixed developer.

For harder results, reduce the proportion of A; for softer results, reduce the proportion of B.

Development time for Panchroma film, 3—4 minutes. Longer development coarsens the grain.

(57) Fine-Grain Compensating Developer

Develop in the A solution of previous formula, using this without dilution. Add to it 10 per cent potassium bromide at the rate of 1½ drops per oz. (3 c.c. litre).

Development time for Panchroma film, 8—10 minutes.

(58) M.Q. for Tank Development

Metol	17½ grs.	(2 grm.)
Sodium sulphite (anhydrous)	220 grs.	(25 grm.)
Hydroquinone ...	35 grs.	(4 grm.)
Sodium carbonate (anhydrous) ...	175 grs.	(20 grm.)
Potassium bromide	17½ grs.	(2 grm.)
Water to up to	20 oz.	(1,000 c.c.)

If crystallized sulphite and carbonate are used, take 440 grs. (50 grm.) of each.

For use mix 1 part of the above with 5 to 10 parts water. Time of development for Panchroma films, 10—20 minutes, according to dilution, at 65 degrees Fahr.

PERUTZ NEGATIVE DEVELOPER

(59) Fine-Grain M.Q. Borax

Pertol (Metol) ...	35 grs.	(4 grm.)
Hydroquinone ...	17 grs.	(2 grm.)
Sodium sulphite (anhydrous)	700 grs.	(80 grm.)
Borax	45 grs.	(5 grm.)
Potassium bromide	2 grs.	(0.25 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take double the above quantity.

The above developer is recommended for all Perutz films. The development times, at 65 degrees Fahr. for Perutz panchromatic films being: Perpantic, 7 to 8 minutes; Rectopan, 5 to 6 minutes; Peromnia, 7 to 9 minutes.

VOIGTLÄNDER DEVELOPER

(60) Fine-Grain Developer

Satrapol (Metol) ...	35 grs.	(4 grm.)
Sodium sulphite (anhydrous)	880 grs.	(100 grm.)
Sod. carb. (anhyd.)	45 grs.	(5 grm.)
Potassium bromide	17 grs.	(2 grm.)
Water	20 oz.	(1,000 c.c.)

If crystallized carbonate is used, take 105 grs. (12 grm.). If crystallized sulphite is used, take double the quantity.

The above fine-grain developer is suitable for all Voigtländer films. For panchro. films Bessapan and Bessapan P, develop for about 8 mins. at 60—65 degrees Fahr.

ZEISS-IKON DEVELOPERS

(61) Rapid Developer for Dish Use

Metol	35 grs.	(4 grm.)
Hydroquinone ...	42 grs.	(4.8 grm.)
Sodium sulphite (anhydrous)	280 grs.	(32 grm.)
Potassium carbonate (anhydrous)...	220 grs.	(25 grm.)
Potassium bromide	14 grs.	(1.6 grm.)
Water to	20 oz.	(1,000 c.c.)

If crystallized sulphite is used, take 560 grs. (64 grm.). If crystallized carbonate is used, take 280 grs. (32 grm.).

Dilute with an equal volume of water, and develop for 4 to 5 minutes at 65 degrees Fahr.

(62) Tank Developer

Metol	9 grs.	(1 grm.)
Hydroquinone ...	18 grs.	(2 grm.)
Sodium sulphite (anhydrous)	88 grs.	(10 grm.)
Potassium carbonate (anhydrous)...	55 grs.	(6.25 grm.)
Potassium bromide	9 grs.	(1 grm.)
Water up to	20 oz.	(1,000 c.c.)

If crystallized sulphite is preferred, take 175 grs. (20 grm.). If crystallized carbonate is used, take 70 grs. (8 grm.).

For use, dilute one part of above with two parts of water, and develop for about 40 minutes at 65 degrees Fahr.

(63) Fine-Grain (Buffered Borax)

Metol	18 grs.	(2
Hydroquinone ...	44 grs.	(5
Sodium sulphite (anhydrous)	880 grs.	
Borax	18 grs.	
Boric acid ...	123 grs.	
Water to make ...	20 oz.	

If crystallized sulphite is double above quantity.

This developer is used without particularly suitable for minia

Development time, about 20 mi degrees Fahr.



tion

Acid Amidol. In the presence of acid, the keeping powers of an amidol developer are improved.

Sodium sulphite	38 gms.	330 grs.
Potassium metabisulphite	9 gms.	80 grs.
Amidol	7 gms.	60 grs.
Potassium bromide	0·6 gm.	5 grs.
Water to	1 litre	20 ozs.

The solution of sulphite, metabisulphite and bromide, especially if it is boiled for a few moments, will keep for a considerably longer period than a plain solution of sulphite.

Chlorquinol (or "Adurol") is closely akin to hydroquinone, but is less affected by cold. Used in composite developers for chloro-bromide papers (*q.v.*). A concentrated one-solution formula is :

Sodium sulphite	200 gms.	1750 grs.
Potassium carbonate ..	300 gms.	2600 grs.
Water to	1 litre	20 ozs.
When dissolved add :		
Chlorquinol	50 gms.	440 grs.

For use with negatives, dilute with 3 parts of water, or more if preferred.

Glycin is now chiefly used in conjunction with paraphenylene-diamine to make a fine-grain developer, or in special developers for chloro-bromide papers (*q.v.*). The following "Huebl paste" is the standard formula for glycin alone :

Sodium sulphite	165 gms.	1450 grs.
Hot water	500 ccs.	10 ozs.
Glycin	135 gms.	1200 grs.
Mix well and add gradually :		
Potassium carbonate ..	625 gms.	5500 grs.
Water to make..	1 litre	20 ozs.

The resulting cream must be well shaken and mixed with 12 or more times its volume of water for use.

Hydroquinone is seldom used alone except for process work ; for normal purposes it is generally used in conjunction with metol in an "M. Q." developer (*see* Metol). Hydroquinone is very inactive at low temperatures, and should not be used below 60° F. A formula for normal use is given below :

Hydroquinone	10 gms.	90 grs.
Sodium sulphite	50 gms.	440 grs.
Sodium carbonate	50 gms.	440 grs.
Potassium bromide	1 gm.	9 grs.
Water to make..	1 litre	20 ozs.

May be diluted with an equal quantity of water if desired.

For line work where maximum contrast is required, the following solution is recommended :

A

Sodium bisulphite	25 gms.	220 grs.
Hydroquinone	25 gms.	220 grs.
Potassium bromide	25 gms.	220 grs.
Water to	1 litre	20 ozs.

B

Caustic soda	45 gms.	400 grs.
Water to make..	1 litre	20 ozs.

For use, mix A and B in equal parts.

Metol is a soft-working developer of high energy, generally used in combination with hydroquinone, chlorquinol, glycin, or pyro. The following is a standard formula for metol alone :

Metol	17 gms.	150 grs.
Sodium sulphite	65 gms.	550 grs.
Sodium carbonate	65 gms.	550 grs.
Potassium bromide	1·8 gms.	16 grs.
Water to	1 litre	20 ozs.

For use, dilute with twice its volume of water.

Metol-Hydroquinone, known also as "Metol-Quinol" or "M.Q.," is by far the most popular type of developer, being equally suitable for plates, films, bromide and gaslight papers. The following is a good universal developer.

Metol	1·5 gms.	14 grs.
Sodium sulphite	25 gms.	220 grs.
Hydroquinone	6·3 gms.	55 grs.
Sodium carbonate	34 gms.	300 grs.
Potassium bromide	0·5 gm.	4 grs.
Water to	1 litre	20 ozs.

For gaslight paper, use undiluted.

For plates and films, dilute with an equal quantity of water.

For bromide paper, dilute with an equal quantity of water, and add 10 per cent. potassium bromide solution to bring the total amount of bromide to that recommended for the paper in use. Without addition, the developer contains 1/10th grain (1 minim of solution) per ounce.

A metol-hydroquinone developer for ***high contrast,*** as when copying photographs on slow plates, is the following :

Metol	1·5 gms.	13 grs.
Sodium sulphite	75 gms.	660 grs.
Hydroquinone	12·5 gms.	110 grs.
Sodium carbonate	37 gms.	320 grs.
Potassium bromide	2 gms.	18 grs.
Water to	1 litre	20 ozs.

The Watkins 'Thermo M.Q.' for use with the Watkins classification of the development

speed of plates and the Watkins Time Thermometer or tables is :

A	Metol	6·8 gms.	60 grs.
	Sodium sulphite	100 gms.	880 grs.
	Hydroquinone	20 gms.	180 grs.
	Water to make	1 litre	20 ozs.
B	Sodium carbonate	102 gms.	900 grs.
	Water to make	1 litre	20 ozs.

For use, take equal parts of A and B and dilute so that the desired contrast is reached with the plate or film in use in a development time of 6½ minutes (dish development) or 24 minutes (tank development) at 60° F.

A *concentrated* metol-hydroquinone developer may be made as follows : Weigh out :

Metol	13·6 gms.	120 grs.
Hydroquinone	55 gms.	480 grs.
Sodium sulphite	185 gms.	1650 grs.
Caustic soda	36 gms.	320 grs.

Dissolve the metol and the hydroquinone in 1 litre (or 20 ozs.) of water at 125° F. When dissolved, add the sulphite, which will produce a white pasty mass. Now stir in the caustic soda, which will produce a clear solution. Filter if necessary.

For use, dilute with 15 times its bulk of water and add bromide as required.

Metol-Chlorquinol is sometimes preferred to metol-hydroquinone as being less affected by low temperatures. In other respects the developers are practically identical in characteristics. Any metol-hydroquinone developer can be converted to metol-chlorquinol by substituting 1.3 parts of chlorquinol for each part of hydroquinone.

Paraminophenol is almost exclusively used in the form of proprietary developers such as Rodinal, Azol, Certinal, and others of the concentrated one-solution type. It is an energetic, soft-working developer giving detail rather than density. The following will give a concentrated developer :

Boiled water	1 litre	20 ozs.
Potassium metabisulphite	300 gms.	2600 grs.
Paraminophenol	100 gms.	880 grs.

When dissolved, add slowly nearly—but not quite—enough of a 25 per cent. solution of caustic soda to re-dissolve the precipitate formed at its first addition. The solution is then filtered and bottled.

For use, dilute with from 10 to 40 parts of water.

Pyrogallol, or pyrogallic acid, is a very favourite developer, especially with the professional. A standard formula (Ilford) for pyro in conjunction with sodium carbonate (pyro-soda) is as follows :

Stock Pyro :

Potassium metabisulphite	24 gms.	200 grs.
Pyrogallol	100 gms.	880 grs.
Water (boiled) to	1 litre	20 ozs.
A. Stock pyro	100 ccs.	2 ozs.
Water up to	1 litre	20 ozs.
B. Sodium sulphite	50 gms.	440 grs.
Sodium carbonate	37 gms.	325 grs.
Potassium bromide	1·2 gms.	12 grs.
Water to	1 litre	20 ozs.

For use mix equal parts of A and B.

The **'B.J.' Non-Staining Pyro-Soda** developer is also very well known. It is as follows :

A. Sodium sulphite	74 gms.	650 grs.
Potassium metabisulphite	18 gms.	160 grs.
Pyrogallol	18 gms.	160 grs.
Potassium bromide	4·6 gms.	40 grs.
Water to	1 litre	20 ozs.
B. Sodium carbonate	55 gms.	480 grs.
Water to	1 litre	20 ozs.

For use, take one part of A, one part of B, and one or more parts of water.

The **Standard Pyro** developer for use in testing plate-speeds by the Hurter and Driffield (H. & D.) method is :

Pyrogallol	8 gms.	70 grs.
Sodium sulphite	20 gms.	176 grs.
Sodium carbonate	14·8 gms.	130 grs.
Water to	1 litre	20 ozs.

The **Watkins 'Thermo Pyro-Soda'** for use with the Watkins Time Thermometer or development tables is :

A. Potassium metabisulphite	18 gms.	160 grs.
Sodium sulphite	100 gms.	880 grs.
Pyrogallol	36 gms.	320 grs.
Water to	1 litre	20 ozs.
B. Sodium carbonate	148 gms.	1300 grs.
Potassium bromide	9·1 gms.	80 grs.
Water to	1 litre	20 ozs.

For use, *see* instructions under Watkins "Thermo M.Q."

Pyro-Metol has often been regarded as by far the best developer for plates that have received minimum exposure ; it is usually so made up as to reinforce the silver image with a strong stain. A standard formula is :

A. Potassium metabisulphite	20 gms.	176 grs.
Pyrogallol	9 gms.	80 grs.
Metol	8 gms.	70 grs.
Potassium bromide	3·5 gms.	30 grs.
Water to make	1 litre	20 ozs
B. Sodium carbonate	55 gms.	480 grs.
Water to make	1 litre	20 ozs.

For normal exposures, take one part each of A, B, and water. For under-exposure, increase the amount of B and dilute further.

Pyro-Metol-Hydroquinone is a combination that has received some notice; it is said to combine the advantages of pyro-soda and M.Q. The following is the B.J. non-staining formula:

A

Metol	4·6 gms.	40 grs.
Sodium sulphite	74 gms.	650 grs.
Citric acid	9 gms.	80 grs.
Pyrogallol	7 gms.	60 grs.
Hydroquinone	7 gms.	60 grs.
Potassium bromide	4·6 gms.	40 grs.
Water to	1 litre	20 ozs.

B

Sodium carbonate	55 gms.	480 grs.
Water to	1 litre	20 ozs.

For use, take equal parts of A, B, and water.

FINE-GRAIN DEVELOPERS

Meritol is a compound developing agent including paraphenylene-diamine; it is used for fine-grain development. The developer consists of:

Meritol	16 gms.	140 grs.
Sodium sulphite	90 gms.	800 grs.
Water to	1 litre	20 ozs.

The exposure required with this developer amounts only to about 1½ times normal.

Metol ('Agfa 14'). The following low-alkali developer, known as "Agfa 14," is widely used as a fine-grain developer:

Metol	4·5 gms.	40 grs.
Sodium sulphite	85 gms.	750 grs.
Sodium carbonate	1 gm.	9 grs.
Potassium bromide	0·5 gm.	4½ grs.
Water to	1 litre	20 ozs.

M.Q. Borax (D76). The following formula, known as D76, is a fine-grain M.Q. developer using borax as the alkali:

Metol	2 gms.	17½ grs.
Sodium sulphite	100 gms.	875 grs.
Hydroquinone	5 gms.	44 grs.
Borax	2 gms.	17½ grs.
Water to	1 litre	20 ozs.

Metol-Glycin is a combination occasionally used for fine-grain development. Two formulae, one with sodium carbonate and one with borax, are:

Metol	0·8 gm.	7 grs.
Sodium sulphite	27 gms.	235 grs.
Glycin	0·5 gm.	4 grs.
Sodium carbonate	24 gms.	205 grs.
Potassium bromide	1 gm.	10 grs.
Citric acid	0·8 gm.	7 grs.
Water to	1 litre	20 ozs.

Development time, 10 to 12 mins. at 65° F.

Metol	5 gms.	44 grs.
Sodium sulphite	100 gms.	880 grs.
Glycin	5 gms.	44 grs.
Borax	10 gms.	88 grs.
Water to	1 litre	20 ozs.

Development time, about 10 mins. at 65° F.

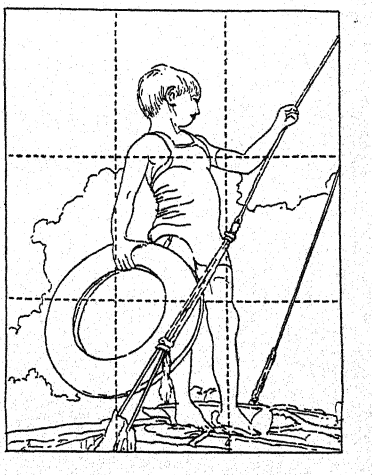
Paraphenylene-Diamine is a slow-acting developer of little energy, much used in compounding fine-grain developers. The following formula *(Sease I)* is typical:

Paraphenylene-diamine	10 gms.	88 grs.
Sodium sulphite	90 gms.	800 grs.
Water to	1 litre	20 ozs.

This developer slows the film; extra exposure, up to six times normal with the fastest films, must therefore be given.

[*Continued in page* 543

Notes on the Composition of 'YOUNG RALEIGH'

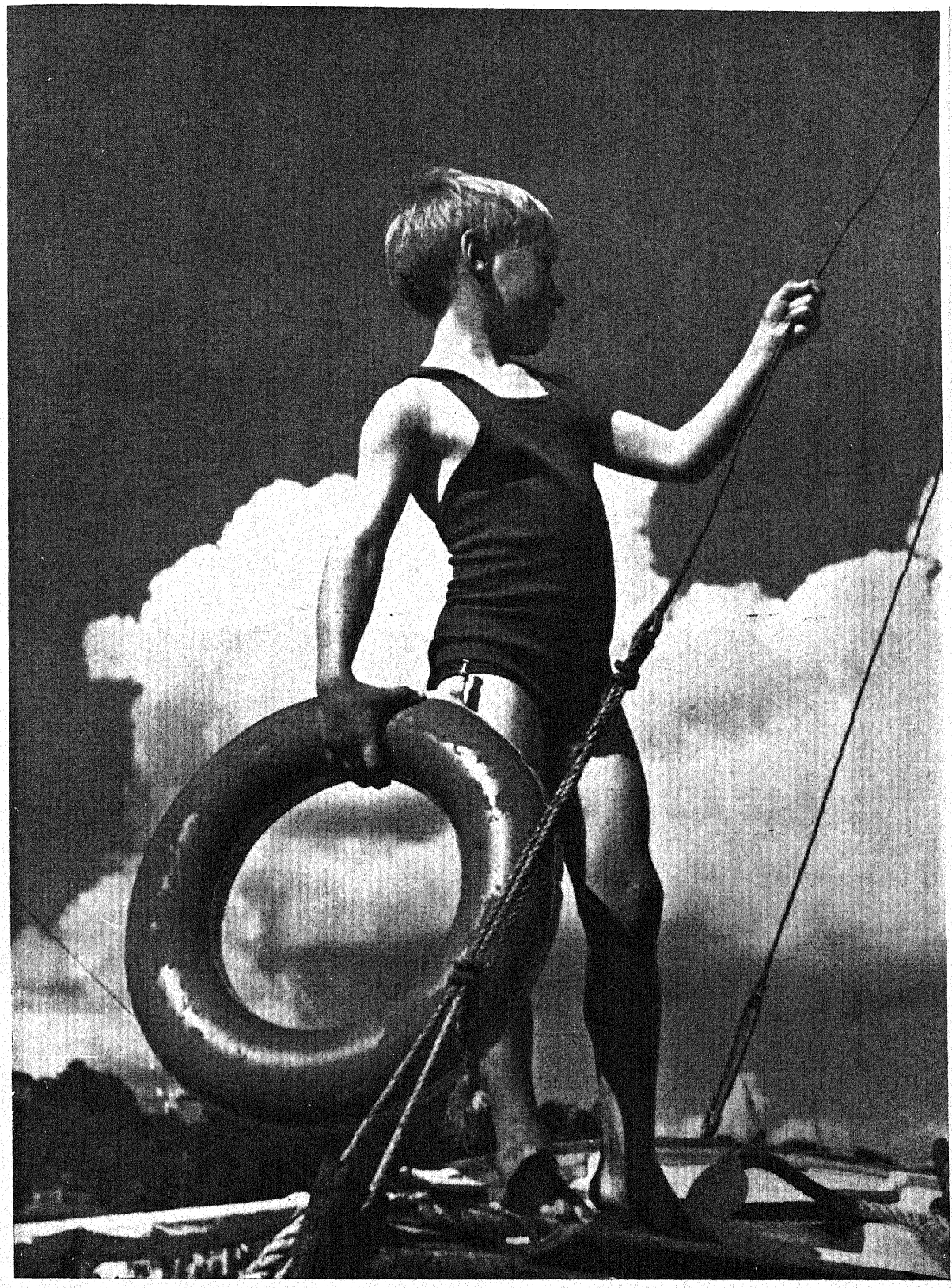


The title of this print is rather unfortunate, as it will remind many of a painting of the real Raleigh in boyhood. Those who recall it will agree that it is tense and emotional, and strongly suggestive of great adventures. The present print is more suggestive of "safety first."

Probably its author had no intention beyond presenting a strong and attractive outdoor figure study; and in this he has certainly succeeded. Its style is that of a lively and popular type of modern work, bold and realistic, with no subtlety of suggestion or appeal to the imagination or emotions.

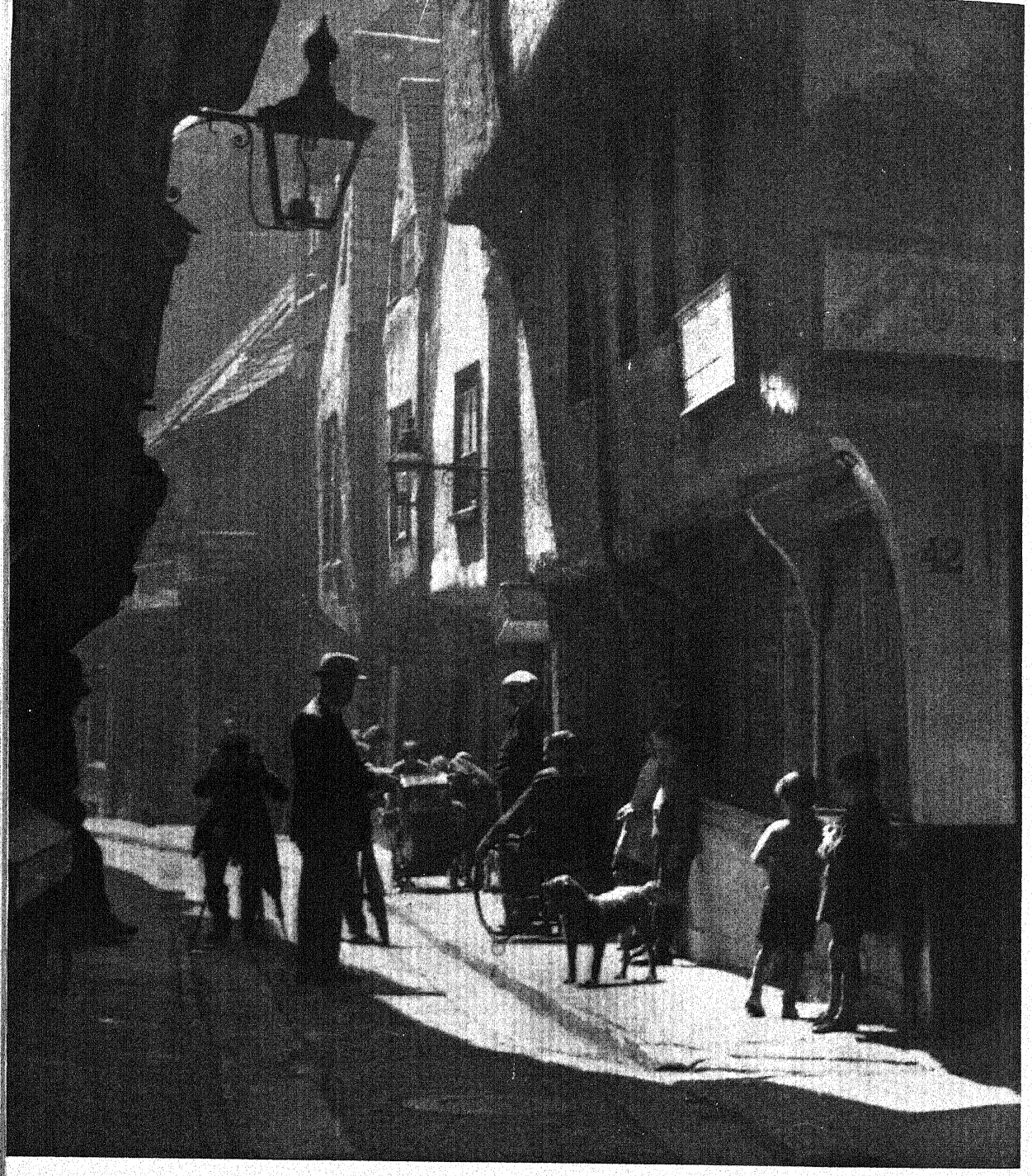
Good as it undoubtedly is, it has its weaknesses when judged by the orthodox canons of pictorial work. The division by thirds in the sketch shows that the buoy and not the boy occupies one of the strongest positions in the picture-space. The lad himself is a trifle too far to the right, occupying the middle section of the space; but this brings his head and shoulders well against the dark portion of the sky. Further, the lighting throws the whole figure into strong relief, with fine modelling. The foreground is rather skimpy and fussy, and barely manages to give the necessary foundation for the figure.

A great asset is the rendering of the simple but adequate sky, the tone values of which are not forced as is too often the case nowadays; and everywhere there are unusually good juxtapositions of lights and darks, resulting in great force and variety of tone. *W. L. F. W.*



YOUNG RALEIGH Edward Bishop

From Leica Exhibition; a striking outdoor snapshot in which a light filter has been effectively used to emphasize colour values. Leica 1/100 sec. at f6.3; No. 2 Leica filter · Isopan film



NOON SUNLIGHT Albert Wallis

From the Intermediate Competition of "The Amateur Photographer"; Ensign Pressman Quarter-Plate Reflex camera; Aldis f4.5 lens; Agfa Isorapid film pack; 1/15 sec. at f5.6

Paraphenylene-Diamine-Glycin composite developers are used to provide fine grain (less fine than paraphenylene-diamine alone) with less slowing of the film. This *Sease III* formula is perhaps both the best and the best-known :

Paraphenylene-diamine ..	10 gms.	88 grs.
Sodium sulphite	90 gms.	800 grs.
Glycin	6 gms.	55 grs.
Water to	1 litre	20 ozs.

This developer requires at most three times normal exposure.

Paraphenylene-Diamine, Glycin with Metol. This combination hardly slows the film at all, but fineness of grain is still further sacrificed. A standard formula is:

Paraphenylene-diamine ..	10 gms.	88 grs.
Metol	6 gms.	53 grs.
Sodium sulphite	90 gms.	800 grs.
Glycin	5 gms.	44 grs.
Water to	1 litre	20 ozs.

Paraphenylene-Diamine, Glycin, and Pyrogallol are used in an American fine-grain developer for which considerable claims are made. The formula, known as *Champlin 15*, contains 32 grains of pyro with 110 grs. each of paraphenylene-diamine and glycin in 20 ozs., as well as benzoic, salicylic, boric and tannic acids, 5 per cent. of isopropyl alcohol, and a few grains of nickel ammonium sulphate. It is given in full under the heading Fine-Grain Developers in page 570.

This developer gives fine grain without requiring any appreciable increase in exposure.

DEVELOPERS FOR CHLORO-BROMIDE PAPERS

Metol-Hydroquinone developers can be used for chloro-bromide papers provided that the proportion of potassium bromide is higher than in a normal M.Q. formula. Satisfactory colours on most papers will be given by :

Metol	2·3 gms.	20 grs.
Sodium sulphite	37·5 gms.	330 grs.
Hydroquinone	9 gms.	80 grs.
Sodium carbonate	28 gms.	250 grs.
Potassium bromide	2·3 gms.	20 grs.
Water to	1 litre	20 ozs.

This developer, used undiluted at not less than 60° F., will give warm-black tones. For warmer tones, increase exposure and add further potassium bromide, diluting the developer also if required.

Chlorquinol, either alone or in combination, is much used for chloro-bromide papers. One standard formula is :

Sodium sulphite	25 gms.	220 grs.
Chlorquinol	7 gms.	60 grs
Sodium carbonate	18·5 gms.	160 grs.
Potassium bromide	1·8 gms.	16 grs.
Water to	1 litre	20 ozs.

Used undiluted at 65° F., this developer gives warm-black tones. For warmer tones increase the exposure, add more bromide, and if desired dilute the developer.

Chlorquinol-Hydroquinone can be recommended where it is desired to obtain a wide range of tones. A suitable developer is :

Chlorquinol	7 gms.	60 grs.
Hydroquinone	7 gms.	60 grs.
Sodium sulphite	62·5 gms.	550 grs.
Sodium carbonate	46 gms.	400 grs.
Potassium bromide	0·7 gms.	6 grs.
Water to	1 litre	20 ozs.

Used undiluted at 65°, warm-black tones are obtained. When warmer tones are required add bromide up to as much as 24 grammes (220 grs.), and increase exposure suitably.

DEVELOPERS OF EARLY AND OBSOLETE TYPE

The following developers have found application in the past, but are no longer used to any appreciable extent in this country. A possible exception is pyrocatechin, which is still used in Germany, and is in consequence occasionally mentioned in British photographic literature. Many of the developers that are mentioned below have not been sold in this country since 1914 or even earlier.

Diamino-Phenol. Amidol was once marketed as diamino-phenol, which is its correct chemical name.

Dianine (Diamino-resorcin). Very little information relative to this developer is now available. It was marketed by Messrs. Lumière about 1908. A formula is :

Dianine	11·5 gms.	100 grs.
Sodium sulphite	34 gms.	300 grs.
Water	1 litre	20 ozs.

Dianol. Is diamino-phenol, or amidol.

Diogen (Sodium amino-naphthol disulphonate). Is closely related to Eikonogen. (*See* page 544.)

Edinol (2-oxymethyl-4-amino-phenol sulphate). A fairly energetic developing agent,

particularly free from tendency to stain or cause fog. Watkins factor 20, which classes it with metol (factor 30) as a " detail-giving " developer. A formula for universal use is :

Edinol	10 gms.	90 grs.
Acetone-sulphite	50 gms.	440 grs.
Sodium carbonate	55 gms.	490 grs.
Water to	1 litre	20 ozs.

Brown tones are said to be obtainable on bromide paper without increase of exposure above normal by using the following :

Edinol	11·5 gms.	100 grs.
Sodium sulphite	57 gms.	500 grs.
Water	1 litre	20 ozs.

Still browner tones can be obtained by increasing the exposure and putting up the amount of sulphite. Or by giving 3 to 6 times normal exposure and developing in :

Edinol	11·5 gms.	100 grs.
Acetone-sulphite	57 gms.	500 grs.
Sodium carbonate	14·8 gms.	130 grs.
Water to	1 litre	20 ozs.

Eikonogen. (Sodium amino-naphthol sulphonate.) A rapid developer tending to give soft images. Watkins factor 9. A single-solution formula is :

Eikonogen	25 gms.	220 grs.
Sodium sulphite	25 gms.	220 grs.
Potassium bromide	0·5 gms.	4½ grs.
Sodium carbonate	19 gms.	165 grs.
Water to	1 litre	20 ozs.

Use undiluted. For softer negatives, omit the bromide.

The following two-solution formula is of the same composition as a " Tabloid " (Burroughs Wellcome) Eikonogen developer :

A.	Eikonogen	9 gms.	80 grs.
	Sodium sulphite	32 gms.	280 grs.
	Water to	500 cc.	10 ozs.
B.	Potass. carbonate (cryst.)	17 gms.	150 grs.
	Potassium bromide	1·1 gms.	10 grs.
	Water to	500 cc.	10 ozs.

For use, take equal parts of A and B.

Imogen Sulphite. An Agfa proprietary preparation, said to be a mixture of well-known developers. Watkins factor 6.

The recommended formula is :

A.	Imogen sulphite	45 gms.	400 grs.
	Water to	500 cc.	10 ozs.
B.	Sodium carbonate	96 gms.	850 grs.
	Water to	500 cc.	10 ozs.

For use, take 1 part A, 1 part B, and 2 parts water.

Kachin. Trade-name for pyrocatechin.

Ortol. This developer is a mixture of hydroquinone and methyl-ortho-aminophenol sulphate. It behaves very much like pyrogallol, giving a brownish image which appears progressively as development proceeds. Watkins factor 10.

The following is a formula once recommended by Ilford, Ltd. :

A.	Ortol	7·5 gms.	65 grs.
	Potass. metabisulphite	1·1 gms.	10 grs.
	Water to	500 cc.	10 ozs.
B.	Potass. carbonate (anhydr.)	37·5 gms.	330 grs.
	Sodium sulphite	27 gms.	240 grs.
	Potassium bromide	1·1 gms.	10 grs.
	Water to	500 cc.	10 ozs.

For use, take equal parts of A and B.

Phenolin. A formula for this developer is :

Sodium sulphite	25 gms.	220 grs.
Phenolin	2·75 gms.	24 grs.
Potass. bromide	1·6 gms.	14 grs.
Water up to	1 litre	20 ozs.

Dissolve in order given.

Pyramidol. Trade name of a developer introduced by the Brugg Chemical Company of Switzerland. A formula is :

A.	Sodium sulphite	16 gms.	180 grs.
	Pyramidol	5 gms.	45 grs.
	Water to	500 cc.	10 ozs.
B.	Potassium carbonate	25 gms.	220 grs.
	Water to	500 cc.	10 ozs.

For use, take equal parts of A and B.

Pyrocatechin. (Ortho-dihydroxy-benzene.) Is a clean-working developer very free from any tendency to fog or stain. Watkins factor 10. A standard formula is :

A.	Pyrocatechin	10 gms.	88 grs.
	Sodium sulphite	19 gms.	165 grs.
	Water to	500 cc.	10 ozs.
B.	Sodium carbonate	96 gms.	845 grs.
	Water to	500 cc.	10 ozs.

For use, take equal parts of A and B.

A developer for tank use, requiring 10–20 mins. for development, is as follows :

Pyrocatechin	3·75 gms.	33 grs.
Sodium sulphite	18 gms.	160 grs.
Potassium ferrocyanide	4·5 gms.	40 grs.
Potassium bromide	0·7 gms.	6½ grs.
Potassium carbonate (anhydr.)	37·5 gms.	330 grs.
Water to	1 litre	20 ozs.

For under-exposed miniature negatives the following has been recommended :

A.	Pyrocatechin	40 gms.	350 grs.
	Sodium sulphite	6·25 gms.	55 grs.
	Water to	500 cc.	10 ozs.
B.	Caustic Soda	50 gms.	440 grs.
	Water	500 cc.	10 ozs.

For use, take 15 cc. (½ oz.) of A and 15 cc. (½ oz.) of B and add 500 cc. (10 oz.) of water.

Development time for fast panchromatic films, 5–7 mins. at 65° F. Keep solution A in a brown bottle or in the dark. (From " Leica News and Technique.")

Synthol. Is a proprietary developing agent of the soft-working " detail-giving " type, having a Watkins factor of 30. A formula for a developer is :

Sodium sulphite	34 gms.	300 grs.
Synthol	6·8 gms.	60 grs.
Potassium bromide	1·1 gms.	10 grs.
Water to	1 litre	20 ozs.

Dissolve the substances in the order given, and use undiluted.

DEVELOPING: (1) PRINCIPAL METHODS CONSIDERED

F. J. Mortimer, Hon. F.R.P.S.

Editor of ' The Amateur Photographer ' and ' Photograms of the Year '

A competent authority on the handling of negatives discusses here the general principles upon which all good processing depends. Even if the amateur does not regularly develop his own films or plates, he will do better photographic work if he gives the subject of development some study. This introductory article is followed by nine others detailing particular methods of development (as listed in page 528)

See also Bromide Printing; Development, the Scientific Basis ; Gaslight Papers

THE nature of the latent image which is created in the sensitive emulsion by the action of light remains, in spite of much research, a matter of conjecture. The highly sensitive plate or film before exposure in the camera presents a blank surface. After exposure has been made it is still precisely the same in appearance as before, yet in the emulsion is the image that has been made by light. This can only be made visible by development.

The action of the developer from the scientific point of view is dealt with in another article in this work by Dr. H. Baines, but it can be briefly stated here that the application of certain chemicals in solution to the exposed plate or film, when conducted under proper conditions in the dark-room, turns the bromide of silver in the emulsion into visible black metallic silver in varying proportions according to the time the light has acted on it.

There is available for the photographer today a great variety of films and plates, each with its own characteristics. The tendency, however, is all towards speeding up the action of the emulsion to the influence of light without sacrificing other qualities in the way of tone rendering and freedom from fog.

Five Groups of Negative Material. Plates and films can be divided into five groups, which are common to both. (*See further under* Films *and* Plates.) These groups are as follow :

Plates or films of ultra rapidity, which respond to the very smallest action of light and are used under most adverse circumstances, when the highest shutter speeds are employed or when the lighting conditions are very bad.

Materials with less speed, but with the compensation that a higher degree of contrast in tonal rendering is possible.

And three groups, progressively slower, the slowest being the highest in contrast value, generally known as " process " plates or films, capable of giving extreme contrast and density for copying purposes, etc., coupled with exceedingly fine grain.

There are, in addition, three other important variations which apply to all speeds and all plates and films. These are "Ordinary," " Orthochromatic " and " Panchromatic."

The first of these variations, in which the question of colour rendering is not the primary consideration, is the type of plate or film that was originally put on the market, and in certain varieties is still available today. They are practically insensitive to red light and nearly so to green and yellow.

'Ortho.' and 'Panchro.' Materials. The orthochromatic varieties have been dye-sensitized to render them sensitive to the yellow and green sections of the spectrum, and the largest number of plates and films now on the market are orthochromatic in character. Panchromatic materials are sensitive to and respond to practically all the colours of the spectrum, including red, and have become more popular for general use with all classes of workers.

The drawback attached to panchromatic material, and which at first proved a considerable handicap to its universal acceptance, was that owing to its sensitiveness to all colours it was necessary to deal with it in total darkness, especially during the earlier stages of development. Ordinary plates and films can be manipulated in red light, and the orthochromatic types in darker red light, but this light would produce fog with panchromatic. This drawback has been largely overcome in modern practice by the use of developing tanks and " time " development.

Coupled with improvements in panchromatic emulsions the speed has also been

increased so that the modern emulsion now presents all the qualities that are necessary for rapid photography, producing negatives that record all colours adequately, and leaving nothing to be desired in the matter of fine grain. Each maker, however, has evolved variations in emulsion speeds, and each has its own characteristics.

The development of sensitive plates and films that have been exposed in the camera must be conducted in the dark-room in non-actinic light—safelight to which the emulsion is insensitive—or in total darkness.

Classes of Development. The actual procedure of development is either to treat the exposed plate or film in an open dish containing the developer, or to develop in a developing tank. The former is more adapted to the older methods of plate development by inspection, but is still continued for both plates and short lengths of film which are passed see-saw fashion, to and fro, through a dish full of developer.

For dish development the plate is placed face upwards in the dish, and the developer, which has been prepared beforehand in a measure glass, is poured with a sweeping action directly on to its surface, taking care to protect the plate from the direct rays of the safelight. The dish is then rocked until the image gradually appears, and this is continued until the image is fully developed.

Some of the modern developing tanks do away with the use of the dark-room altogether, particularly if roll-films are used. These can be put into the camera by daylight, removed by daylight and then fed into the tank also in actinic light, the time of development being ascertained according to the constituents of the developer and its temperature. If development is conducted by inspection or by the factorial method, a dark-room is required.

If a developing tank is being used, the plates are generally held in a rack which fits inside the tank, and the developer is poured in slowly after the plates are in. Roll-films are developed in special tanks in which the spool is wound round a central core protected by a celluloid apron or held in spiral grooves. Different patterns of tanks, however, are operated in various ways, and the beginner should follow the instructions given with the apparatus.

For the worker who prefers to develop by judgement rather than by the time or factorial method, a certain amount of experience will be necessary to know when to stop development.

In the first place, the density—or general opacity—of the negative depends very much on exposure. For instance, if one second is the correct exposure for a certain subject, and two plates are exposed on that subject, giving to the one a quarter of a second and to the other four seconds, and both exposures are developed in the same dish for the same time, it will be found, after fixing the negatives, that the plate that had the shorter exposure has resulted in a much " thinner " negative (*i.e.* a negative with a less dense deposit) than the plate that had the longer exposure. Thinness is the result of under-development; that is, of keeping the plate for too short a time in the developer. One may thus be sure that, if full exposures are given, the negatives will be dense enough if developed long enough. If over-developed, however, the contrasts will be altered in the rendering of the subject. This is referred to again in page 549.

Agitation of the Solution. After the developer has been poured over the surface of the plate in the developing dish, the dish should be rocked during the process of development. The reason for this is that the developer shows a tendency to uneven action if allowed to remain undisturbed on the surface of the plate, owing to a possible settling of the ingredients of the solution, and to the fact that the developer became exhausted in the parts where the heaviest deposit of silver occurred. By rocking the dish the solution is kept in its correct form and its action is more even.

In tank development, in which plates are inserted vertically in a rack, the necessity for keeping the developer moving still remains, as in the vertical position the tendency is for the developer to leave streaky marks unless some agitation is given to the solution. When films are developed in a tank it is also necessary to keep the developer agitated from time to time, to ensure even development. It is also claimed by many workers that the action of the developer is more energetic when regularly agitated.

Many of the curious markings that arise on films and plates can be traced to this matter being overlooked.

After development is complete the plate is rinsed in clean water and transferred to the fixing bath (*q.v.*). Care should be taken not to expose the film or plate more than is necessary even to the dark-room light, especially before and during the first part of the development. It is a good plan to cover over the developing dish, or otherwise shield it from the light.

In a normal developer there are four essential ingredients : (1) the developer proper or " reducer " ; (2) the accelerator, which hastens the action of the developer ; (3) the restrainer ; and (4) the solvent or water (as explained in detail under the heading Developer). The developing agent may be pyro, hydroquinone, metol, amidol, etc. The accelerator is usually an alkali, such as the carbonates of potassium or sodium, and the restrainers are the bromides of potassium or sodium, etc. If a developer of normal strength is applied to a plate that has never been exposed to light and allowed to act for a long time, it will be found that there is a general reduction of the silver salt. This general reducing action or chemical fog is, however, less if some soluble bromide be added. The addition of a sulphite to a developer is to prevent too rapid oxidation and consequent discoloration of the developing agent. Incidentally, this prevents staining of the hands and the gelatine of the film.

Temperature. A factor that has a definite bearing on the image that is produced by development is the temperature of the solution employed. Some developing agents, such as hydroquinone, become practically inert at low temperatures ; others are affected less, but all are definitely rendered more rapid in their action by an increase in temperature, and, in addition to this speeding up of the developing action, as the temperature rises the character of the image undergoes a change in the matter of contrast and density. Coupled with this behaviour of the developer under certain conditions of temperature is the time allowed for the developer to act fully.

A developer employed at a temperature of 65° F. will develop a properly exposed plate or film in a certain time. When the temperature is ten degrees less, a much longer time must be given for the action of the developer to achieve the same result, while if the temperature is increased ten degrees the time necessary for the image to develop fully will be much shorter. These factors of temperature, coupled with the time of development, have been the subject of much research and were investigated by the late Alfred Watkins, who not only formulated the factors of time and temperature of development but went further and evolved a theory, which has subsequently been accepted as a definite form of practical work, which he termed " factorial " development.

Time. In the factorial method of development Mr. Watkins discovered that with any given developer the time of appearance of the image gave an accurate indication of the speed at which the developer was working ; and that any variation of temperature, or of the amount of alkali (within limits), which lessened or increased the time required to attain a certain degree of contrast, also lessened or increased, in the same ratio, the time of appearance. This " time of appearance " is the exact time elapsing between the pouring on of the developer and the first appearance of any trace of image. (For details, *see* Factorial Development *under* Developing : (3), page 555.)

The Watkins method of factorial development, therefore, is to develop the plate for a certain multiple of the time of appearance, and a standard degree of contrast will always be secured. This factorial system necessitates the visual inspection of the plate or film at the commencement of development, but it may remain covered from the first appearance to the completion of the development.

The development time necessary to produce a certain phase of contrast in a negative is affected also by the " development speed " of the particular plate or film employed. This is a matter quite apart from the time and temperature speed. A Watkins table of plates and films divided into classes, tabulated according to their " development speeds," is also published. These vary from " very quick " to " very slow," and indicate the time necessary to secure a certain density of image with normal development. The practical worker, however, who sticks to one

make of plate or film will adopt a factor that then remains constant. Should he change to another plate, instead of varying the time of development for it, according to the table, dilution of the developer at a normal temperature of 65° F. will produce the same development time.

Control of Development. It has been found from practical experience that altering the composition of the developer *after* development has started, with a view to correcting errors of exposure, is of no real value. It is possible, however, to compensate for over-exposure by employing a stronger developer with a low factor, *provided this is used from the beginning*, since the alteration of the developer during development makes no difference to the result. The only control by the time of development that is placed in the hands of the photographer is to increase the density and, incidentally, the contrast by prolonged development. The amateur in particular will get his most successful results by continuing to use one developer only for a particular plate or film and learning to master it thoroughly before attempting any other.

The control of development, therefore, amounts to this: judgement must be exercised as to when to stop development. In the early days, when plates were always developed in a dish, this period of development was ascertained by removing the plate from the dish and examining it in the dark-room light. The older worker became expert in this method, generally by observing how far the image had developed through to the back of the plate. Provided the worker was familiar with the particular plate in use, development by inspection became a very accurate guide and resulted in good negatives. But it was not always possible to do this if a variety of different plates were employed, as apart from the development speed of the emulsion, some brands of plates showed the image right through to the back before development was complete, while with other slow, thickly-coated ones even a very faint image at the back meant over-development.

To quote Mr. Watkins in his reference to factorial development: "This method of development recognizes that a developer does not always work at the same speed chiefly owing to changes in temperature, but also owing to variations in different samples of the developer and alkali. The time of appearance makes exact allowance for this variation and the factor indicates how much longer (for the particular developer) development must be continued to attain a standard amount of contrast."

The multiplying factor for the time of development is also known as the "Watkins factor," and while this varies with different developers it is not altered for different strengths or dilutions of the same developer, with the exception of pyro and amidol. Factorial development, however, is capable of personal interpretation, and its application depends on the degree of contrast the photographer wants in the negative. Although definite figures are given in the published tables for different developers, they are a guide for the first trial only and may require modification to suit other photographers' fancies as regards contrast, and in practice it will be found that extreme under- and over-exposure affects the application of factorial development very considerably.

Questions of Contrast. It must not be overlooked that the best amount of contrast or steepness of gradation for one printing process is probably not the best for another. The quality of a negative should, therefore, not be judged by its density but by its contrast range in tones, and its printing quality in the finished result on the selected printing paper. If too much contrast is secured with a chosen development factor, a shorter one should be used in future to give less contrasty results, and vice versa.

This brings us to another matter, namely, contrast in the subject. This affects the rendering of contrast in the negative, which is again translated to contrast in the print. The ideal print should register as nearly as possible the same tonal range and contrasts as the original subject so far as limitations of a black-and-white print are capable. It must be recognized, however, in any graphic representation of a subject on white paper, the limitations of tone can only be indicated in a photograph by the blackest deposit of silver at one end and white paper at the other. In both cases these fall very short of the darkest shadows and the highest lights in nature. The result, therefore, must of necessity be a compromise, with a much restricted compass of tones. To get the best

results it is desirable in the production of the negative that the tones of the original subject should be as adequately represented as the emulsion will permit, and given correct exposure and development this result should be achieved, yet all the tones may be altered by prolonging the development time, to the extent that the deposit is piled up in the highlights and the contrasts become different and probably entirely wrong.

The ultimate control exercised by time in development is a control over the contrast between the tones in the negative. With a good plate a short time gives too little contrast—a flat, grey print ; a long time too much contrast—a hard black-and-white print ; while the right time for the particular plate, developer, and temperature gives a negative in which all the varying tones in the subjects are represented by varying tones in the print, from the highest light to the deepest shadow. The aim of time development is to attain this ideal—a correct contrast ; while the aim of correct exposure is to ensure that the different tones in the subject are represented by similar tones in the negative, the amount of contrast between them being secured by correct development (*see further under* Contrast).

Three Factors in Development Time. The factors that affect the time of development are " make of plate or film," "developer," and " temperature." " Subject " is not included as a definite factor affecting time, for it is a fact that the same time is correct for all classes of subject, if the aim is to represent the contrast between the tones as seen by the eye.

In the early days of " stand " or tank development the instructions given assumed that, of the above, the developer was the only factor affecting time, variations in the make of plate were ignored, and practically no information was given as to the effect of temperature on the time, which was usually also ignored.

The experience of every photographer is that some plates give contrast in a much shorter time of development than others. In fact, it is possible to find brands (especially if deteriorated by long keeping) which are incapable of yielding sufficient contrast with *any* time of development.

There are two ways of making the necessary allowance for different brands of plates or films. The one is to keep to a standard dilution of developer and vary the time for different groups of plates, the other way is to keep to a standard time and vary the dilution of the developer for different plates.

The time required to give the standard contrast in the negative with a given plate at a given temperature represents the energy of the developer, and must be found by trial.

Temperature Coefficient. There is another attribute of a developer (apart from its energy) that must also be ascertained if it is desired to draw up an accurate table of times at different temperatures. This is its temperature coefficient (see p. 550), and represents the sensitiveness of the particular developer to temperature changes. Thus, hydroquinone is far more greatly affected by changes of temperature than is metol. The former, therefore, has a high temperature coefficient and the latter a low one. It must always be remembered that a table for times and temperatures (or a thermometer marked with development times, as in the Watkins instrument) cannot be right for all kinds of developers, as they have different coefficients.

A metol developer, for instance, and a hydroquinone developer can be so adjusted in the correct amount of alkali or in dilution as to require the same time at 65° F.—say, five minutes. But try them both at 45° F. and, while the metol will require seven and a half minutes, the hydroquinone will require about eleven and a half minutes.

The coefficient of a developer is the same at all dilutions (within limits), but the use of a bromide in a developer increases its coefficient.

As a rough rule the energy of a developer varies with its dilution ; that is, if a developer is diluted with its own bulk of water it takes twice as long to do its work. Dr. Mees has pointed out that there is a variation from this rule with some developers, as metol and hydroquinone, and also when there is air dissolved in the water. In these cases the time is longer than proportionate to the dilution. With glycin and pyro-soda the time is proportionate to dilution.

Negative Quality. In the development of a negative, particularly at the present time (as so many prints are made by

enlargement today), the quality of the deposit must be observed carefully to produce a result that will enlarge readily and successfully. The type of negative of full density and possibly strong contrast that will give a good straight print by contact is not always the ideal negative for enlarging. The correct type of negative for that purpose is one containing a good range of tones, but which is not too dense. To compensate for the thinner character of such a negative, it is fortunate that today there is an extensive number of printing papers available—bromide, chloro-bromide and gaslight—which will produce good prints from practically any type of negative.

It might be argued from this that in view of this range of printing material the quality of the negative does not matter, but to do so would overlook the exposure time necessary for making an enlargement. Too dense a negative renders the process tedious and laborious and demands a strong illuminant if the enlargement is big. At the same time the actual process of enlarging tends to increase the contrasts, particularly in a dense negative that is already over-contrasty. It is true that a soft printing paper will compensate for this to a certain extent, but not so readily as in contact printing. It must be taken as an axiom that no " shadow detail can be developed that has not been registered on the sensitive emulsion by the action of light." Prolonged development will not produce an image that is not there, no matter what developer or method of development is employed, but the contrasts of the image may be altered according to the action and constitution of the developer.

In practice, if a normal developer is applied to a correctly exposed plate or film (at 65° F.) the high-lights will first commence to darken in the solution. This will be followed by the appearance of the half-tones, and then by the shadow detail. They will all go on gaining density gradually ; and a point will then be reached when all the tones and detail of the shadow portion of the image have been developed fully ; but the high-lights, having received a greater amount of light-action, will continue to develop and gain in density. For this reason over-development will increase the " contrasts " of a normally exposed subject.

Development Dilution. If, however, the development is conducted by what is known as the " water bath " method, contrasts can be made softer. With this method of development the exposed plate or film is first treated to a normal developer for a short time, and then transferred to plain water. In the water the developer that is retained in the clear portion of the emulsion, *i.e.* the shadow part of the image, will continue its action, while that which is retained in the high-lights is exhausted proportionately by its production of the denser image.

After remaining in the water for a short time the plate or film is again returned to the developer to take up additional solution, and the process is repeated several times.

It will be seen that by this procedure the shadow or thin portions of the negative can be fully developed, and the high-light portions only partially. When all the shadow detail is fully out it will be found that a soft-contrast negative has been produced.

This frequently gives rise to the statement that development by this method or in a dilute developer produces more detail in the shadows. Actually it cannot produce detail that has not been put there by light-action, but by contrast with the denser portions there is apparently a greater amount of tone present in the shadows.

The developing of bromide and gaslight prints is dealt with under the headings Bromide Printing and Enlarging *and* Gaslight Papers. Instructions for the making up of Developers will be found under Developers.

TEMPERATURE COEFFICIENT OF DEVELOPERS

The temperature required for the development of a negative can be calculated to suit the developer used. Mr. P. C. Smethurst here shows how the temperature coefficient can be related to time of development

The temperature coefficient of a developer is the factor by which the time of development at one given temperature must be multiplied to give the equivalent development time at a temperature 10° C. (18° F.) lower. It varies with the developer used, but not, apparently, with the emulsion.

Since it has been found that the time of appearance of the image can be used to determine the temperature coefficient, it is usual to expose a negative, cut it in two, and

develop the two halves at different temperatures in the developer to be tested. The coefficient is then calculated as follows :

$$\text{Log. of Temp. Coeff.} = \frac{10 \times (\log. T_1 - \log. T_2)}{t_1 - t_2}$$

where T_1 and T_2 are the times of appearance of the image at the temperatures t_1 and t_2.

Equivalent development times are found in practice by a simpler method. An exposed negative is cut into four strips, each strip being developed at a different temperature and the times of appearance of the image noted. Suppose that the correct development time at 65° F. was 10 minutes, and that the times of appearance were :

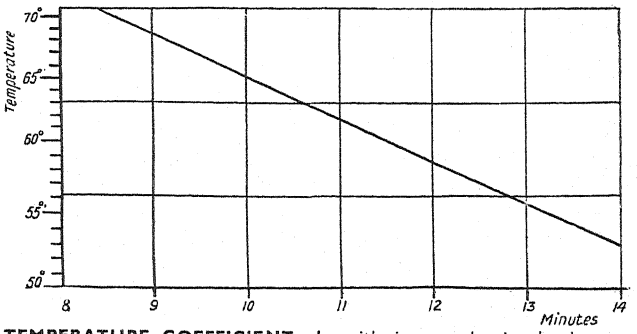
55°—40 sec., 60°—35 sec., 65°—30 sec., and 70°—26 sec.,

the equivalent development times will be :

55°— 10 × 40/30 = 13½ min. ; 60°— 10 × 35/30 = 11½ min. ; and 70°— 10 × 26/30 = 8¾ min. approximately.

These values will plot as a straight line if the scale of temperatures is a logarithmic one, and the values for the last can be obtained from a book of tables or else traced from the illustration here. Once the straight line joining the points has been drawn, the correct equivalent development time for any temperature in the range can be found at a glance. In the illustration the temperature coefficient is found by finding the equivalent times for any two temperatures 18° F. apart and dividing the larger by the smaller. A reference to the scales shows it to be 1.67 in this particular case.

P. C. SMETHURST, A.R.P.S



TEMPERATURE COEFFICIENT. Logarithmic curve showing development times at different temperatures

DEVELOPING: (2) THE DISH METHOD FOR PLATES & FILMS

The simplest method of development, in a dish, is not as commonly used as it used to be before time and temperature methods were perfected, but it is a satisfactory method for the beginner. He is able to watch the progress of the negative and learns a good deal by experimentation. In the following articles the treatment of plates, cut film, and roll-film are fully discussed and directions are given for the home manufacture of a suitable dish

ALTHOUGH tank development, by the time and temperature method, is becoming increasingly popular, development by inspection, enabling the growth of density and contrast to be seen by looking through the negative, is still a favourite method.

Dish Development of Plates or Cut Film. The plate or film is laid, emulsion side upwards, in the dish and the developer poured over it in an even sweep. This point must be emphasized, as unless the negative is entirely covered at once by the developer, markings will be caused. As soon as all the developer has been poured in, the dish should be gently rocked throughout the period of development.

Development may take from one to ten minutes, according to the strength, composition, and temperature of the developer, but with a standard developer at 65° F. the time is usually from 2½ to 3 minutes. If the high-lights (in exteriors the sky) appear first and are gradually followed by the half-tones and then the darkest parts of the subject, it may be assumed that exposure has been more or less correct. If the high-lights rush up almost at once, accompanied almost at the same time by the half-tones, it is certain that the plate or film has been over-exposed. If the high-lights and the darker tones appear slowly the exposure was too short.

The plate or film is allowed to develop until it is judged that the process is complete, and a certain amount of experience is necessary to know when this point has been reached. The negative must be viewed by the transmitted light of the dark-room lamp, an operation which must not be unduly prolonged. As the image loses a certain

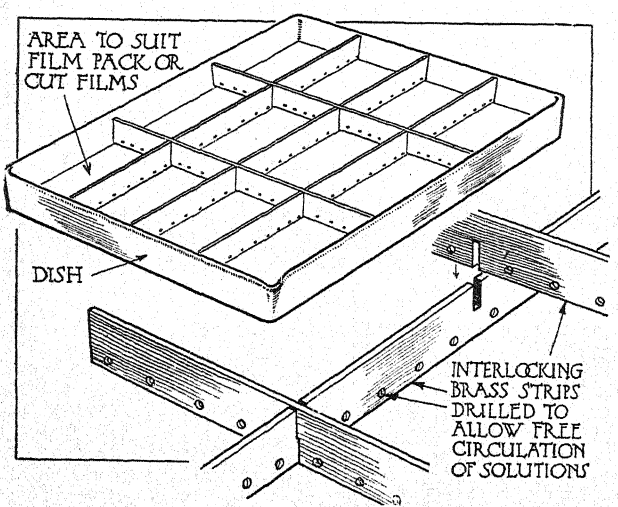
amount of density when it is afterwards fixed, development should not cease until the high-lights are nearly opaque. If the highest densities show distinctly at the back of the plate, when viewed by reflected light, as black patches, this is usually a sign that development has been carried sufficiently far.

With plates of slow and medium speeds, the gradual building up of densities as development proceeds can easily be seen, but with very rapid plates development often seems to have stopped when the negative has attained an average density, whereas actually the process is still going on, and if development is allowed to continue there is a great risk that the negative, when fixed, will be found too dense for printing. As soon as development is sufficient the plate or film should be rinsed and transferred to the fixing bath.

A Useful Dish for Developing Film Packs and Cut Films. The development of a single cut film or a film from a film pack is quite satisfactory by the dish method, but when more than one film is developed in the same dish there is a general tendency for the films to bunch when the dish is rocked.

The simply constructed device illustrated is suitable for the development of twelve $3\frac{1}{4} \times 2\frac{1}{4}$ in. cut films or the contents of a film-pack, and obviates this difficulty.

It consists of five strips of thin brass, three of which are 12 inches long (*i.e.* the length of the dish) and the other two 10 inches.



DEVELOPING DISH. A very simple dish can be constructed for the developing of cut films and film packs, made of thin interlocking strips of brass

It is necessary to interlock each strip, and in order to do this cuts are made half-way through the width of each strip as illustrated. Holes must also be made in the strips, preferably near the bottom. By placing the strips so that each cut coincides, a framework is made. This is then placed in the dish.

When the developer is poured in the dish it will run freely and the dish can be rocked gently without the negatives slipping.

A cover, such as a piece of card or three-ply, placed over the dish will then save it from stray light, and it can be safely left.

The size of the dish, etc., need not, of course, be adhered to, as it depends largely on the size and the quantity of films to be developed.—*L. G. Hone.*

Dish Development of Roll-Films. The usual method adopted for developing roll-films is to pass the film from end to end through the solution in a developing dish after it has been first passed through a dish of plain water. The film is held in a loop so that the lower end of this loop is under the surface of the solution, and by holding the ends, one in each hand, the length of film is see-sawed through the developer until the process is completed.

This method has the disadvantage of being difficult to carry out successfully in total darkness when panchromatic material is used. Even if the film is not panchromatic, constant exposure to the dark-room lamp may be detrimental, no matter how " safe." But this see-saw method of developing roll-film continues to be popular among amateurs, and if conducted in a shaded corner of the dark-room can be quite effective, especially if development time is speeded up by the use of concentrated developer.

The employment of very strong solutions of Rodinal, Azol, Certinal and similar concentrated developers —diluted about one in four—gives negatives excellent in gradation and of fine grain, and the fact that development is completed in a very short time helps to overcome any trouble likely to arise from fog in the dark-room. For quick development, *see further under* Development: (10) " Instantaneous " Method.

Hints for the Beginner. For the "see-saw" method three dishes are required, although small basins can be used quite successfully. These should be wide enough inside at the bottom to accommodate the width of the film.

Any convenient room that can be completely darkened at night will serve as a dark-room. A good ruby lamp should be placed on a table near the dishes, but shielded with a piece of card placed in front so that only reflected red light reaches the work.

The top of the table should be protected against splashes, etc., by a piece of American cloth or other similar material, or a newspaper will serve temporarily.

At first, the novice should use ready-made developers. He can obtain from any dealer a bottle of Azol, Rodinal or other concentrated developer, which will serve every purpose, and only needs diluting with water—a little goes a long way, and full instructions are given with every bottle.

For fixing the negative after developing some "hyposulphite of soda," ordinarily known as "hypo," is wanted. A pound costs very little. A quarter of this dissolved in a pint of water and kept in a large bottle constitutes the fixing-bath.

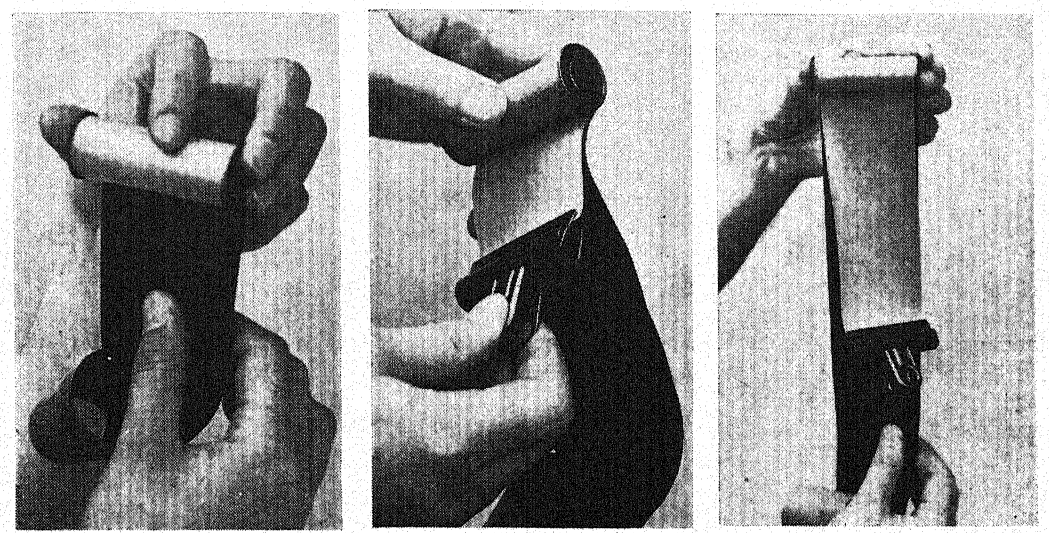
All is now ready to develop the first film that has already been exposed in the camera. The room is in darkness except for the ruby light (it is assumed that an ordinary film —*not* panchromatic—has been used for the first exposures).

The three dishes, or basins, are placed in a row within easy reach. Number one—on the left—contains plain water ; number two contains the developer, diluted according to the instructions issued with it ; number three contains the fixing-bath. In each case use plenty of solution in the dishes.

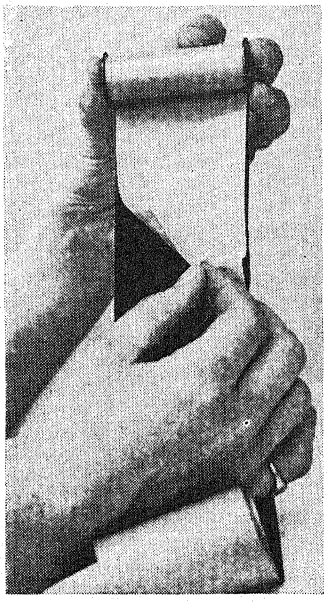
The spool of exposed film, which has previously been removed from the camera and sealed, is now taken, and the paper band broken with the finger-nail. The film is then unrolled in the manner shown in the illustrations, taking care always to avoid touching the sensitive surface with the fingers.

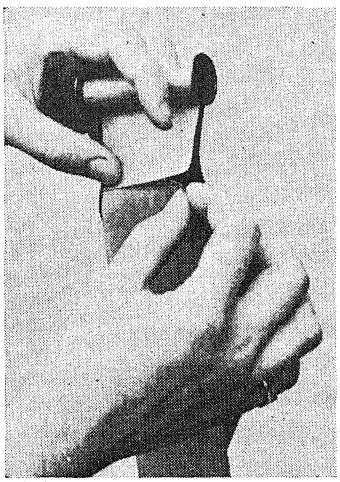
When unrolled and separated from its red or black backing paper, it is held at each end by the fingers or a paper-clip, and allowed to assume a U-shape, the middle portion sagging.

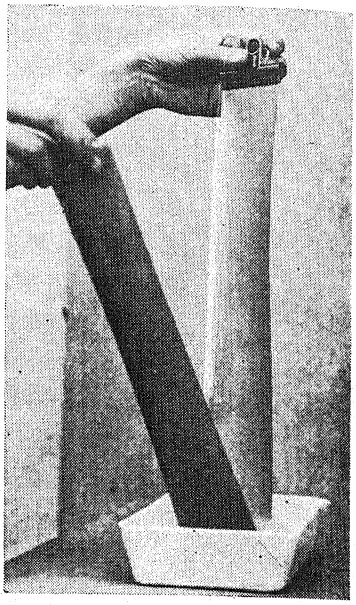
Carefully let the lower end of the "U" dip into the dish of water ; then lower one hand so that one end of the film is immersed ; now gradually lower the other hand, raising the first, so as to draw the film through the water. It will quickly become quite limp, and it should be drawn through the water two or three times, and then removed and lowered into the dish of developing solution in the same manner. The film is now passed backwards and forwards through the solution steadily and evenly without stopping.



UNROLLING A SPOOL. Break seal and, holding spool between thumb and second finger, draw out black paper backing, using first finger to prevent spool from turning too freely. Grip end of film in a metal paper-clip. Allow paper-clip to weigh down film, which should hang free while paper support is unrolled







DEVELOPING A ROLL-FILM. Backing paper is torn off when second end of film is reached, and another paper-clip fastened, as page 553. End of film is detached when reached. Clips are left on if film is developed by see-saw method

In about a minute it will be seen in the dim reflected red light (to which the eyes have now become accustomed) that a series of dark patches are appearing on the white strip of film. These are the negatives appearing, and to many amateurs this is the most fascinating and exciting part of photography. Shortly, each exposure, eight or sixteen, according to the camera used, will be clearly indicated as a dark rectangle.

Do not be afraid of over-developing; go on until each little square can be seen at the back of the film. The film can then be run through the plain water again, and after a couple of turns transferred to the fixing bath.

In the fixer the film will clear and all the white portions will be dissolved out. As soon as this happens the film can be allowed to roll up in the dish and the white light turned on. The film should be kept in the hypo solution a little longer, however, to ensure that it is thoroughly fixed.

If the film is now held up by one end and examined by looking through it, each little picture will be seen, but as a negative; that is to say, the highlights will be black and the shadows will be clear.

The film now needs to be washed to remove all chemicals, and this can be done in a large basin of water—allowing it to coil up and uncoil half-a-dozen times and then changing the water for fresh. After about six changes of water the film can be pinned up to the edge of a shelf in a dry, warm room, and in the morning it will be dry. It can then be cut up into separate negatives, which will be ready for printing.

Alternative Methods for Roll-Films. An alternative method that finds favour with many workers is to use a small, deep developing dish, with a very smooth interior, and when this is full of developer insert the film and let it roll up. Then with the finger-tips gently unroll it, keeping it under the developer, and allow it to roll up again at the other end of the dish. Keep on repeating the process of rolling and unrolling until it is developed. This plan is, however, likely to cause marks or scratches unless the handling is conducted very gently and carefully, but it has the advantage that it can be done in the dark by touch only.

A third method that will appeal to many workers—especially as two films can be developed at the same time, is to take advantage of this natural tendency of roll-films to curl, but without danger of scratches.

This method can also be conducted in the dark. The paper backing is first stripped off the film, as for all the other methods. This, by the way, is best done by separating the film from the paper with both hands held close together, letting the film roll up in one hand as the paper is unrolled and collected with the other.

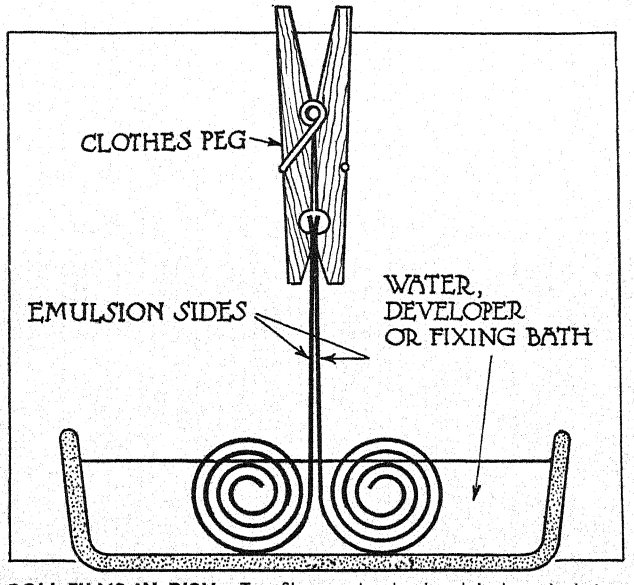
The stripped film is fed into a dish of plain water by unrolling and allowing it to roll up again under the water. The free end is then gripped by a wooden clothes-peg, or preferably by a spiked film clip, which is less likely to slip, carefully lifted straight up and out of the water, and slowly lowered into the dish of developer. A deep quarter-plate dish with four ounces of developer will be ample.

The peg or clip holding the film is now gently moved straight up and down with one hand, while the other guides the lower part of the film and keeps it from straying from the dish. A very little practice will give the correct height to lift the film just clear of the solution, and as it is lowered slowly it rolls up again under the surface.

If it is found that the flat developing dishes cause scratches on the gelatine coating on the back of the film, small china basins about three inches high and concave at the bottom will serve perfectly. These allow the film to touch the lower part of the basin with its edges only, and the entire middle of the film is held clear of any surface. Be sure, however, to see that there are no moulding marks in the bottom of such china basins.

From this it is a simple step to the development of two films back to back as indicated in the sketch. These are lifted and unrolled and lowered and rolled in precisely the same way as one film. The development time will be the same if they are of the same variety.

When development is complete the films are transferred to water and rinsed in the same manner. The peg should then be changed for another, specially kept for the purpose, and fixing in the hypo bath can be conducted in a similar fashion.



ROLL-FILMS IN DISH. Two films can be developed back to back in a dish if they are held by a wooden clothes peg

(3) FACTORIAL DEVELOPMENT: THE WATKINS METHOD

The name of this type of development is derived from the fact that the time required for the image to appear is multiplied by a single known factor. The method here explained by Mr. David Charles, F.R.P.S., has the great advantage of simplicity, the manufacturers supplying the numerical factor for each agent used

Factorial development is a system of developing negative images to a standard printing contrast by means of one factor only—namely, the time taken for the image to commence making its appearance. This time is then mentally multiplied by a known "factor," and the result of this simple sum denotes the total period at the expiration of which development should cease.

The factor by which the initial period is multiplied is a number given to the particular agent used, and within limits it does not alter with variations in age, strength, temperature, or composition of the particular formula employed, nor in most cases with different plates or films. Thus, if a "factor" of 6 is found to produce a negative of satisfactory density with a particular agent, the same factor employed in this way at any subsequent time with that agent should produce the same type of negative, irrespective of other conditions.

Factorial System in Practice. Alfred Watkins, the inventor of this system, quotes the following factors as a basis :

Metol	30
Rodinal	30
Metol-hydroquinone	14
Pryo-metol	9
Hydroquinone	5

Immediately the developer is applied to the plate or film a developing clock or stop-

watch is started, from zero. As soon as a highlight detail makes its appearance note is taken of the number of seconds which have elapsed, the emulsion may be then screened from further light, and the said number of seconds multiplied by the factor will indicate when to remove the negative and fix it. For instance, if Rodinal or one of the other paraminophenol developers is in use (*see* Developers (1) Classes, page 534), the suggested factor is 30. If the first sign of an image appears in 10 seconds, this multiplied by the factor 30 gives 300 seconds, *i.e.* 5 minutes. In that case the total development time will therefore be five minutes.

The variety of printing-paper contrast is so great, and individual taste is no less varied, that any textbook factors can be quoted only as suggestions for testing the system. If the contrast is found on first trial to be too great the factor should be reduced for further employment of that particular developer. If the contrast is too weak, obviously vice versa.

Exceptions. The factorial system breaks down in cases of extreme over- and under-exposure. With pyro and amidol developers the required factor does vary with the strength of the developing solution, and if either of these developers is favoured the same concentration should be used consistently, or the factor altered for a different strength. In the case of certain types of subject, too, the system should be employed with caution. For instance, with such subjects as include a highlight of a brilliance out of proportion with the rest, it is better to time the appearance of the next brighter detail. Such subjects would be interiors in which brightly-lit windows appear; night-views with actual lamps included, and the like. Subjects of inherently flat contrast should be developed with the aid of a temporarily higher factor. Such subjects would be new statues, copies of pencil and most water-colour sketches, and such technical subjects as sections of castings, new woodwork, and so on. If such subjects are comparatively frequently handled, the higher factor decided upon would become standard practice.

The factorial system is particularly convenient for those who have occasion to develop only a few exposures intermittently, as is the case in many research laboratories and factories for record purposes; and in these circumstances the above remarks will be found to assist towards obtaining results of consistent quality.

Desensitizing plus Factorial. The coming of emulsions of extreme sensitivity with the accompanying necessity for using very dim safelights or none at all appeared to put the factorial system of development out of general use, simply because it became impossible to observe properly the onset of image formation. But desensitizing, which permits development by light of quite unprecedented strength and comfort, obviously puts an entirely different complexion upon the subject, for it renders examination of the initial image much easier than ever before.

But it should be noted that desensitizing alters the behaviour of some developers, especially " straight " hydroquinone, which then assumes a similar character to metol—*i.e.* a rapid start and slow density building. For this reason different factors should be established for any selected developer with and without preliminary desensitizing.

Personal Factor. No system of development by observation is entirely independent of variation according to the characteristics of the person operating it, and still more by the conditions under which he works. For instance, most people's observation is liable to severe inaccuracy if dark-room work is commenced immediately after working in a brighter illumination. For this reason it is strongly desirable, for success in using the factorial system, to adopt as far as possible standard conditions—*i.e.* a set distance of the same safelight and a time allowance sufficient to accommodate the sight to the reduced illumination. The practice of desensitizing is an obvious help in both these directions.

With some emulsions and with some developers one may experience hesitation in deciding the precise onset of image appearance. In some cases this is a personal disability. The plan may be adopted here of using a very small source of safelight closer to the work, such as a pocket flash-lamp suitably screened. If development is started in the dark, and this small lamp is flashed on intermittently, the absence and then the presence of detail is more easily decided.

DEVELOPING: (4) TANK DEVELOPMENT TIME & TEMPERATURE

David Charles, F.R.P.S.

After discussing developing tanks in general, Mr. Charles here explains the finer points of the technique required in their use, especially as regards temperature of solutions and development period. His article is followed by a list of typical modern tanks

TANK development of photographic images consists of their total immersion in a diluted developing solution contained in a light-proof and chemically inert vessel. It is practically confined to the development of negatives in the case of " still " photography, but to both negatives and positives in the case of cinematography. The emulsion surface is usually disposed vertically.

Exceptions to this are the drum on which a cine film is wound and which is revolved while dipping into a tray of solution, and the Agfa Rondinax tank for hand camera films in which the film is revolved continuously with the emulsion surface disposed laterally. In both these instances only part of the film is immersed at any one moment,

Tanks are of many kinds, and still more varieties as regards appearance. In the rectangular tank for developing plates, they are slipped into the grooves one by one, by hand, in the dark or by a suitable safelight. Tall tanks are provided with bars and clips for developing lengths of roll-film, and flat films of all sizes are developed in tanks of other proportions by the aid of metal frames having a clip at each corner. Cine film is wound spirally on flat frames of wooden slats.

In all these forms of tank the exposed material is usually lowered into developer kept standing ready. Between batches a " freshener " is added to the developer and adjustments made to the duration of time, if necessary. Much research has been done, and with considerable success, on the production of a developer for mass-production purposes which will give even working throughout its life (*see* D. & P. Work, pages 478-488).

Importance of Temperature. In the largest installations, as in the development of single spools in amateur practice, the maintenance of constant temperature is regarded as the basis of consistent work. The expenditure of many hundreds of pounds to attain this condition may be regarded as a measure of the importance of this particular factor.

Tanks for Amateur Use. Practically all tanks made for use by amateur photographers can be used in daylight, in the sense that their lids are light-trapped so that, when loaded, the tank may be taken into comfortable light and then filled with developer and fixer in turn and processing completed without need for any return to the dark-room. A few tanks are obtainable into which a roll-film can be loaded in ordinary light, making a dark-room superfluous for production of negatives. These appear to be confined to one size of spool, namely, the popular size called " 20," 120," " 620." Dark-room loading film tanks may be classified into those which take one size of spool only and in which, with one or two exceptions (*e.g.* Carbine, Beda), the film is wound between the turns of a so-called " apron " upon a spindle before insertion into the tank proper.

This apron is a long strip of flexible inert material, with raised edges which serve to separate the turns of film, and so allow the solutions to pass between. Next there are tanks whose spindles are designed to take spools without aprons, and finally those of similar character whose spindles are adjustable to various widths for various sizes of film. For plates and film-packs special tanks are obtainable with racks into which the exposed material is loaded and then inserted into the tank as one unit, as in the case of roll-films. After insertion of the spindle or rack holding the material to be developed, the light-trapped lid is put on and clamped.

The Actual Development. The developer is then poured into the light-trapped aperture in the tank or in its lid provided for the purpose. There are certain simple but important details which should be attended to, both in the preparation of the developing solution and in the matter of pouring in.

The developer must have been thoroughly mixed, and it must have no loose particles of chemicals or of foreign matter in it, for these would cause markings of various kinds; if the solution is not homogeneous, naturally it will act unevenly over the pictures. The pouring in must be continuous. Spasmodic or intermittent flow of developer into the tank may have the effect of producing slight irregularities of density in the negatives, with sharp demarcation where one part received developer before another, and another more noticeable effect is that of air bubbles, seen as transparent spots in the negatives. These may arise either through intermittent wetting of the emulsion surface, or from actual bubbles which jerky pouring naturally encourages. It is often recommended to employ a preliminary wetting with plain water. This would reduce the liability to irregular markings, but is unlikely to prevent or to remove air bells, which, once formed, often stick obstinately. A better method for nervous people who fail to pour smoothly is to use a funnel by which to introduce the solution into the tank.

Time and Temperature. The whole foundation of tank development is based upon the principle of developing for a fixed time at a predetermined temperature. The actual time during which any particular developer formula is allowed to act depends upon certain factors which are always determined in advance.

These factors are :

1. The formula itself.
2. The temperature of the solution.
3. The brand of the sensitive material.
4. The contrast of negative required (*i.e.* the type of sensitive paper to be printed on); and, in exceptional circumstances—
5. The type of subject photographed.

Manufacturers of materials and of developers supply with them, or on request, tabulated details of formulae, strength of solution and temperature times calculated to produce negatives of satisfactory quality.

The advantages to be gained from tank development lie far more in the regularity of negative contrast and in subsequent ease of printing than in the obvious convenience of the method itself. Therefore it is preferable to standardize as far as is practicable the factors which can be so regularized. For instance, if a set of satisfactory negatives has been obtained on a particular brand of emulsion with a certain formula, the same formula used at any subsequent time in the same way will produce similar negatives of precisely similar gradation and printing quality.

Standardizing the Factors. By the expression "using the same formula in the same way" is meant having it of reasonable freshness, of always the same strength and temperature, and developing for the same length of time. It is quite practicable, of course, to make variations in the length of time to compensate for differences in temperature. But these variations must depend entirely upon the particular developing agent or combination of agents employed, because some of them are very much more susceptible than others to fluctuations of temperature (*see* Developers).

Excepting in circumstances of extreme difficulty, such as those which explorers are subject to, it is usually much more satisfactory for the user of amateur-size tanks to follow the large-scale user by bringing the tank and the developer to approximately the standard temperature rather than to make allowances in the time.

Methods of Temperature Regulation. In cold weather there are many easily arranged methods from which to choose, based on the water-bath system. A large basin of water can be brought to the right degree of warmth, which is between 65° and 68° F., either by adding hot water from a kettle, by the aid of an electric immersion heater, or the like. Standing the jug containing the prepared developer and also the tank in this will very soon make the whole correct, and when the tank has been charged it can be again stood in the basin of water. It is obvious that the greater mass will maintain the same degree of warmth for a longer time than will the small tank by itself.

In hot weather ice is an obvious means of reducing solutions to normal temperature, but the photographer has always at hand another substance which can be used, with due precautions. When hypo is dissolved in water the latter drops many degrees in temperature. Consequently, if hypo crystals be placed in a tall glass vessel, and this is stood in the basin of water, on pouring water on to the crystals the whole will be

very rapidly cooled. Naturally every care must be taken not to allow the slightest speck of hypo to get beyond the confines of its own container. Other methods of cooling may be the use of the home refrigerator, and the domestic evaporation porous cover.

Development Times at Higher Temperatures. When a formula for a developer is published, or a packet of developer bought, information as to a suitable time for developing films of different types is nearly always given. In some few cases this information is complete.

In winter this need cause no difficulty, for the developer can easily be warmed up to the required temperature, but in hot weather many have to develop with a solution at room temperature. It is therefore useful to know the time allowance when developing at higher temperatures up to, say, 85° F.

Developers and films vary a little in the extent to which they respond to changes in temperature, but the table given here is more than near enough for all practical photographic purposes. It is based on the assumption that the user already knows how long to develop his favourite film in his usual developer at 65° to get the kind of negative he likes. For every minute at 65° the table gives the number of seconds required at higher temperatures to give the same result.

Temperature	Time	Temperature	Time
65° F.	60 secs.	77½° F.	38 secs.
67½° F.	55 secs.	80° F.	35 secs.
70° F.	50 secs.	82½° F.	32 secs.
72½° F.	46 secs.	85° F.	29 secs.
75° F.	42 secs.	87½° F.	26 secs.

Regulating Density and Contrast. If negatives produced by a given formula, for the developing time recommended by either the makers of the developer or of the sensitive material, be found too weak in contrast for the brand of printing-paper favoured, it is usually better to develop longer, or to use a more " robust " agent, than to employ a more concentrated formula.

If, on the other hand, negatives are consistently found to be too contrasty, the remedy is to use a more dilute solution, rather than to develop for a shorter time.

Once negatives have been produced which print satisfactorily upon the selected paper, repetition of the same procedure will produce similar negatives. A change made either in the brand or variety of material, or in the developer formula, may demand corresponding alteration in the development time.

An exception to established conditions is when subjects of quite unusual contrast, or lack of it, are frequently photographed. As in any other method, especially extreme contrast in the subjects calls for still more diluted developer, and vice versa.

General Notes. It is sometimes recommended to employ a " stop-bath " between emptying out the developer and pouring in the fixing solution. It is the case, however, that an acid-fixing solution which has not been too repeatedly used prevents further developing action unless white light is allowed to reach the emulsion before it has had time to soak in. In a totally enclosed tank, with slow development, a stop-bath appears superfluous.

Some developers will permit of developing several fully-exposed films in succession; but it should be realized that a tank developer is weak in chemical content, and that it absorbs considerable " restrainer " from the emulsion. Extra time, which depends upon many factors, should be given to successive films in a small tank.

It is standard practice to fix and to wash the film or other material without removal from the tank. But the tank must be well rinsed out, and also thoroughly dried, before developing further material. The last condition applies particularly to roll-film tanks which are loaded in the light. Slight moisture may cause the film to jam when loading.

HOW TO USE A DEVELOPING TANK

By using the modern type of developing tank the development of films by the amateur is made easy and sure. The procedure is explained in the following article and illustrated in page 560

(1) The backing paper is first removed from the film (in the dark-room, of course, or the film will be fogged), and the corners of one end are cut off with scissors. This end of the film is then clipped under the spring on the reel-axle, as shown in Fig. 1.

(2) If your fingers are quite dry and free from chemicals, the second method (Fig. 2) is far easier. The thumb unrolls the springy film as you wind it up with the transparent celluloid " apron."

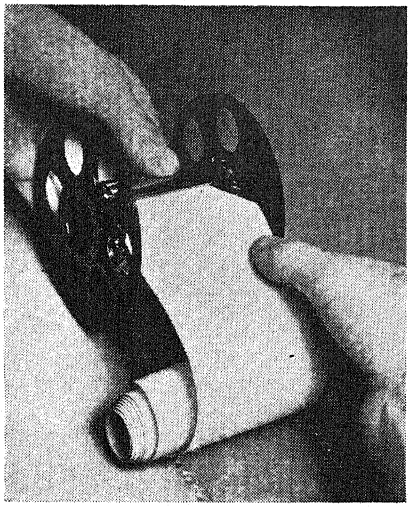


Fig. 1. End of the film is clipped to reel of tank in dark-room

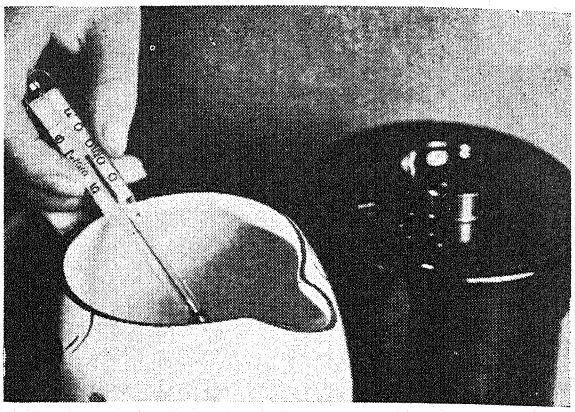


Fig. 4. Lid is fixed to tank and temperature of developer is tested. 65° F. is about right

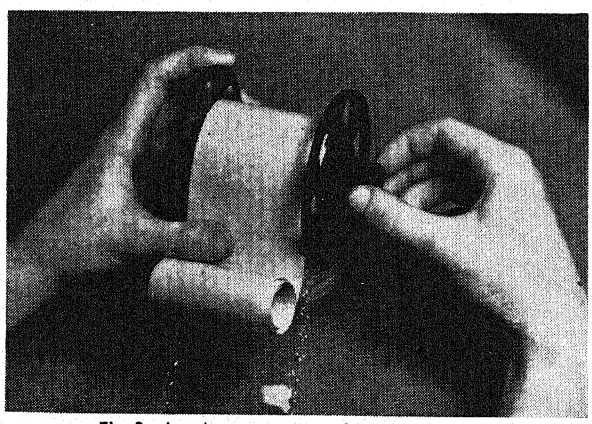


Fig. 2. An alternative way of winding on film. Note transparent celluloid "apron"

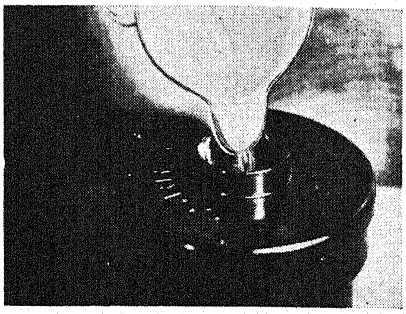


Fig. 5. Developer is poured into tank through filling orifice, which also accommodates the spindle

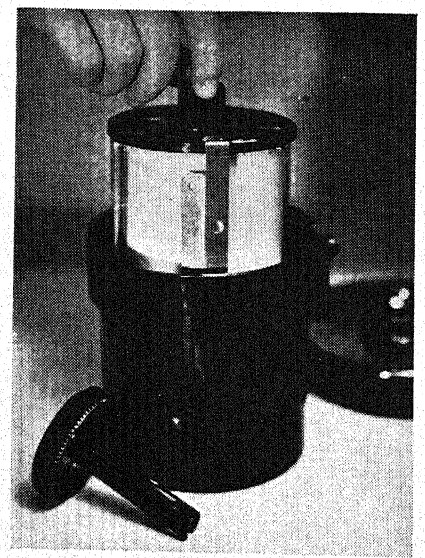


Fig. 3. Left, after film and apron are completely wound on reel, the clip is fixed and the whole is dropped in tank

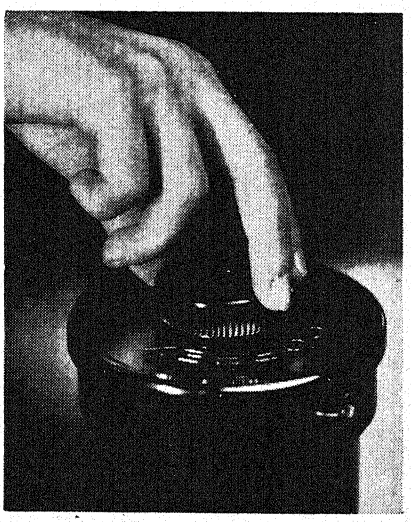


Fig. 6. Above, the spindle with knurled knob is carefully inserted and secured, and at intervals it is rotated, as shown, until the developing process is completed. Fixation and washing can, if required, be also carried out by means of the tank

(3) Having clipped the other end of the " apron " to the reel, drop the whole into the empty tank and put on the lid. See that the lid is fixed properly in place, and the white light can then be switched on.

(4) The temperature of the developing solution is one of the most important things in tank development (and so is a really clean jug). The thermometer should read between 65° and 68°. Warm water in winter and a little ice in summer will help that way.

(5) Pour the developer into the tank steadily without stopping. You want no bubbles or " tide-marks." The latter sometimes occur through " starting and stopping." If you are the least bit nervous, practise first with an empty tank and plain water.

(6) When the tank is full of developer give the knob at the top an occasional turn to keep the contents on the move. The time of development is settled beforehand, according to the developer used. (Tables for this purpose are supplied by the makers.)

When developed, pour out the developer and rinse the contents with water. Pour away the water and replace with the hypo fixing bath, which should be allowed to work for a quarter of an hour.

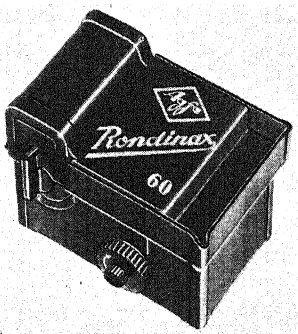
Pour away the fixing bath and run a number of changes of clean water through the tank until the film is washed.

The strip of film negatives can then be taken out and hung up to dry. They are then ready for printing.

A SELECTION OF MODERN TANKS

AGFA RONDINAX, for 3¼ × 2¼ in. spools only

Strongly constructed of bakelite, this tank separates the film from the backing paper and rolls it on to a spool made with spiral grooves. The film is kept in continuous motion by turning the

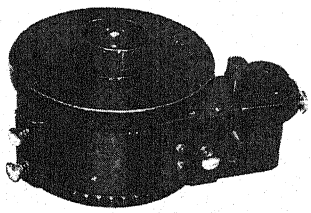


Agfa Rondinax Tank

mill-edged knob, and both fixation and washing can be carried out in the tank. Special attention has been given to the design in order to prevent the formation of air-bells on the film. About 4 to 5 ozs. of developer are required. Price £1 13s. Messrs. Agfa Photo, Ltd.

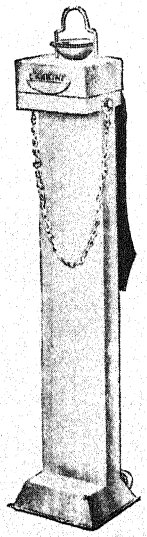
ENSIGN CARBINE, for 1⅝ × 2½, 2¼ × 3¼, 2½ × 4¼, and 4¼ × 3¼ in. spools

This tank allows every operation to be carried out without difficulty in daylight. It is practically automatic in action and has no changing box, apron or grooves. The film is attached to the backing paper and both are stretched out straight by means of a plunger device. Made in solid brass, enamelled and plated. Developer required amounts to about 37 ozs. Prices, 15s., 21s., 25s., and 30s., according to size. Ensign Ltd.


Super-Kino Tank

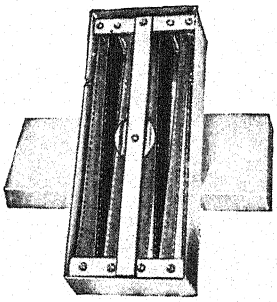
SUPER-KINO, for 35-mm. films (24 × 36 mm. negatives)

This tank has a metal loading chamber into which the spool is fixed. From this it is fed into a reel with spirally-grooved flanges by means of sprockets. After sealing up the loading chamber, the film is developed, fixed and washed in running water without removal from the tank. About 16 ozs. of solution are required. Price £3 3s. Norse Trading Co.


Ensign Carbine Tank

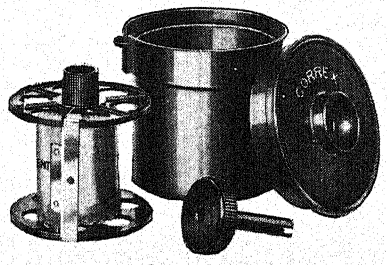
CORREX, for V.P., 3¼ × 2¼ in., and 2½ × 4¼ in films

With this tank the film is wound on to a spool and developed with an apron. The latter is made of non-absorbent material, and with the film is rotated by a knurled knob. An " agitator " is fitted for occasionally revolving the film during development for the purpose of removing any air bubbles that may have been present in the solution. Prices, £1 5s. and £1 10s. Sands Hunter & Co., Ltd.


Beda Tank

BEDA, made for 35-mm. film and for spools of V.P. and 3¼ × 2¼ in size

In this developing tank the film is carried in a series of open loops, these being supported at the extreme edges of the film. Both sides are quite exposed and free of the metal supports.

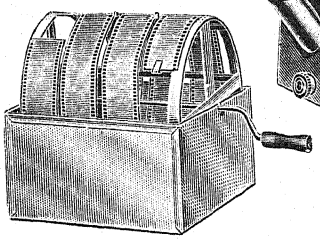


Correx Tank

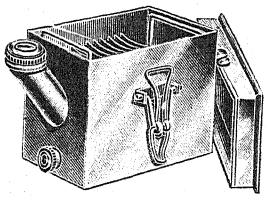
It is recommended that the film be removed from the tank for fixation and washing. About 20 ozs. of solution is required. Prices: for Leica size, £1 10s.; for V.P. and 3¼ × 2¼ in. films, £1 5s. and £1 7s. 6d. respectively. Luminos Ltd.

DALLAN Tanks for film packs, plates and roll-films

Made in stainless steel



Dallan Tank for 35-mm. film

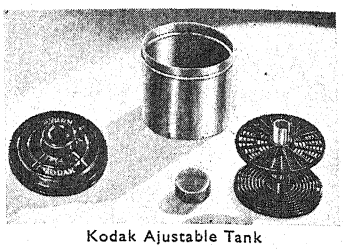


Dallan film-pack Tank

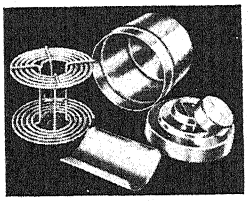
and nickel steel. The roll-film tank does not permit of daylight-loading, but is designed to give very rapid development with only 6 ozs. of solution. The film pack tank holds twelve plates or films. Prices from £1 4s. to £1 10s., according to size. The Dallan developing, fixing and washing tank consists of a simple drum with crank handle, the whole being supported in a rectangular container. Made for 35-mm. films. Price £2 5s. David Allan.

KODAK Adjustable Tank for taking all sizes of film from 35-mm. to 4¼ × 2½ in.

The tank consists of a stainless metal circular chamber equipped with a light-tight lid and a central spindle with two spirally-grooved end pieces. Adjustment for suiting the spool for different sizes of film is carried out by simply moving one end piece on the spindle against the action of a spring-loaded device. About 24 ozs. of developer is required to develop an eight-exposure 3¼ × 2¼ in. film, and proportionately less for other sizes. The price of this tank is £1 10s. Messrs. Kodak, Ltd.



Kodak Ajustable Tank



Nikor Tank

NIKOR, for V.P., 35-mm., 2¼ × 2¼ in. and 3¼ × 2¼ films

Made of stainless steel with welded joints. Specially designed to give rapid loading. No marks are left on the negative since the only contact point is at the extreme edge of the film. Wide spacing of the film and absence of aprons ensure good circulation of the solution. Temperature control is easily secured by placing the tank in a pan of water maintained at the required temperature. Price £2 5s. R. F. Hunter, Ltd.

DEVELOPING: (6) METHODS FOR FILM PACKS

W. L. F. Wastell, Hon. F.R.P.S.

Past President R.P.S.

Many important facts and features associated with developers and developing have already been fully dealt with in the five preceding articles. All six articles are necessarily related to one another and should be read in conjunction with the four that complete this series. These four articles deal with Miniature Films, Fine Grain Films for Miniatures, Physical Development, and the "Instantaneous" Method

In general work I use more film-packs than any other kind of sensitive material, and my only objection to them is their relatively high price. I will here describe my own method of development in detail.

Breaking the Pack. Put the twelve films (3½ × 2½ in. or quarter-plate) into a 5 × 4 in. plate box, from which they are taken two at a time. I always develop in twos, and I prefer to be able to give longer or shorter development, according to circumstances. That is why I do not use a tank.

Developing. My developing and fixing dishes are half-plate size. Not only are they of different coloured xylonite, but the first has one notch in the rim, and the second two; so that I am never in doubt as to which is which.

In the first dish I put enough developer to cover the films easily, and the number of films I put through it depends on what developer I am using. I have a piece of thick card to cover the dish, and on this I put the two films, face down, the backing-paper protecting them. Before development the backing-paper is gently torn off.

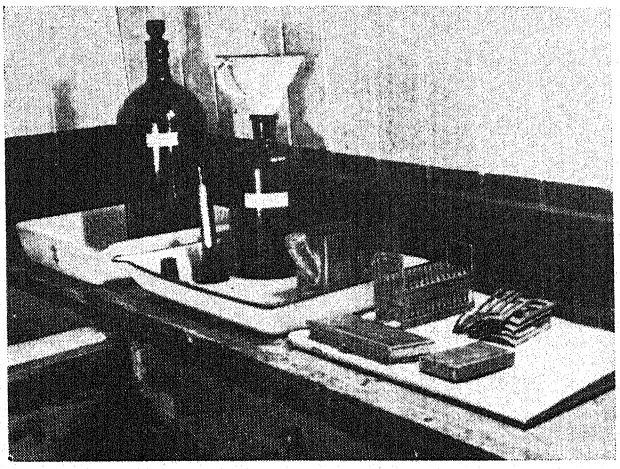
I then grip this edge of the film with vulcanite forceps (better than metal) and drag the film backwards and forwards through the developer, till it will lie flat. Then I do the same with the second film, which meanwhile has been held face down on the card. The two films lie side by side in the dish, which is covered and rocked. Presently I take a peep to see what is the subject of each film, so as to develop accordingly.

Fixing. When I consider development complete I rinse the films in a 12 × 10 in. dish of water, and put them side by side in the acid fixing bath. Here they remain while I develop the next two films, which ultimately go over the others in the fixing

bath. Then I draw out the first two, examine them in a good light, and put them back in the same position, although fixation is probably complete.

Just before I am ready to put another pair in the fixing bath I draw out the bottom two and transfer them to another 12 × 10 in. dish of water. So there are never more than four films in the fixing bath.

Washing. Ultimately all the twelve films are in the dish of water, ready for washing. I drain off the water and put the dish under an anti-splash tap. The stream of water is allowed to fall on the sloping side of the dish, and with a little practice it is easy to make the films circulate in the dish without their turning over. After a round or two the tap is turned off.



FILM PACK DEVELOPMENT. Work bench prepared for film pack development by tank. Careful arrangement of apparatus and detail equipment assists in smooth operation, especially as the work must be done usually in darkness

The process is repeated many times—drain, swirl, rest; drain, swirl, rest. During the rest intervals I wash the other dishes, and the graduates, and put them away, except the other 12 × 10 in. dish.

Cleaning and Hardening. This other dish is replenished with clean water. I get a plug of cotton-wool and swab one of the negatives well under the water in the first dish, taking special care to clear off every trace of the adhesive at one edge. I regard this as of great importance. Soon all the swabbed negatives are in the second dish, where they are treated once or twice to the drain, swirl, rest.

Now the whole batch is transferred to a dish of formalin—one ounce of formalin solution to nine ounces of water—and kept moving for about three minutes. This thoroughly hardens the gelatine. Then they go back into water, but no further washing is necessary. The formalin solution can be used repeatedly.

Drying. I now take a half-plate sheet of glass and a piece of chamois leather. The latter is soaked in water, wrung as dry as possible, and made into a smooth, flat pad. The rinsing and wringing must be repeated frequently.

A film is laid face down on the glass and the water rubbed off with the leather pad, from middle to edge one way, and the same the other way. Then the negative is turned over, and the film side treated similarly. There is no soft gelatine, and no adhesive. When the film is slid off the glass it is clean.

I stick a glass-headed push-pin through the top left-hand corner and pin the film to the edge of a wooden shelf. Why the left-hand corner? The right-hand one will do as well, but it should always be the same one, or the films will not all hang the same way and will take more space. As I take the dry films down I snip off the corner where the pin has been. More fuss? Well, when you realize how hard the burr is you will remove it.

I would rather spend time and trouble in getting clean and spotless negatives than in trying to remedy defects that could have been avoided. That is why I am "fussy."

(6) TANK DEVELOPMENT FOR FILM PACKS

While the developing tank provides a simple means of developing film packs, certain precautions, as here described by Mr. Christopher Kirk, must be taken in using it for this type of negative

The amateur who uses film packs will not take long to realize the advantages of a tank for their development. Film packs are expensive, and unless considerable care is taken when developing the films in a dish, scratches and markings will occur very

easily. Tank development is quite simple if the same routine is carried out each time. As the proceedings are to be carried out in total darkness, everything must be ready in its place on the work-bench.

My method is as follows: The developer and hypo, kept ready made up, are brought to an even temperature—about 65° F. A sheet of newspaper is laid on the bench, and on it are placed the rack, the sheaths, the lid of the tank and the pack to be developed still in its wrapper. Two dishes are put on the bench, and in one is placed the bottle of developer, the tank, and a thermometer, and in the other the bottle of hypo. The tank is filled with the developer and its temperature noted. A large funnel is placed in the developer bottle, for use later on.

When everything is ready the light is switched off, and the films are loaded into the sheaths and placed in the rack. The rack is then raised and lowered several times in the developer to remove any air bubbles, and the lid put on. The light is now turned up and the time noted. While development is proceeding the tank is reversed and shaken at frequent intervals.

When the time for development is up the light is switched off and, holding the tank with the bottom outlet screw upwards, the screw cap is removed. Then close the hole with finger and, holding the tank over the funnel, carefully remove the lid, and allow the developer to run back into its bottle. (Remember to filter it before using again.)

The films are next given a rinse by filling and emptying the tank several times with water. After rinsing, the tank is put in the dish with the hypo bottle and the hypo poured in, remembering to replace the screw cap on the tank first. When fixed for the correct length of time the films are given their final hour's washing in the tank. Remove the bottom screw cap for this so as to allow the heavier hypo-laden water to escape.

Do not use an acid hypo in the tank. It may remove the nickelling from the inside and small particles of plating will settle on the films with disastrous results. Plain hypo without any potassium metabisulphite will work just as well, but discolours quickly. Unless it is used for a second batch almost at once, it should be thrown away and a fresh bath made up. After use, dry the tank very thoroughly and place it and its parts in front of a fire to remove all traces of moisture.

DEVELOPING: (7) METHODS FOR MINIATURE FILMS

R. G. Lewis

The fact that miniature camera negatives are eventually enlarged many diameters makes great care and accuracy in the development of the film absolutely necessary. This article by a trade expert gives advice on the best ways of carrying out this work and provides information which helps the amateur to avoid many defects. The subject is amplified by a further article (Section 8) on Fine-Grain Development for Miniatures

IN the old days, although, of course, various special developing tanks were marketed and used by the more particular amateur, perhaps the most common practice was to develop a film by the "see-saw" method; that is to say, by holding the film at each end, and then passing it to and fro through the developer contained in a rather deep dish (*see* page 552). This method was haphazard in the extreme. It involved frequent inspection of the negative in order to ascertain whether the correct density had been reached, as in an open dish of this type work by the time-and-temperature-method, which avoids the necessity for inspection, is not easy. It also took a great deal of experience to judge by the light of a dim dark-room lamp when the negative had received correct development.

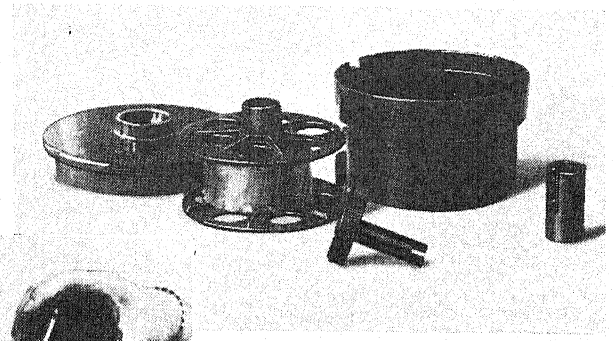
The modern method of developing miniature films by comparison, although simple of operation, is an extremely scientific one. Some miniature negatives measure as little as one inch square, and enlargements even of moderate size from so small a negative would show enormous defects as a result of even the slightest markings on the negatives themselves. It was therefore essential to produce a method by which miniature films could be processed practically untouched.

For this purpose a number of eminently satisfactory developing tanks have been designed. Some of them contain a spiral core into which the film is inserted. Others employ a form of celluloid band which is

wound, together with the film to be developed, round a spool, which is then inserted in the tank. Perhaps the most definite and at the same time the most simple in use for the beginner is the type having the band.

The tank is made of some acid-proof material which is also not affected by any of the solutions which are poured into it, and developing, fixing and washing can therefore be carried out in it without any danger of chemical interaction. It is so arranged that once the film has been safely inserted all subsequent operations can be carried out in daylight. The dark-room is therefore required only when putting in the film. After that the light can be switched on, and developing, rinsing, fixing and final washing can be carried out in complete comfort.

Owing to the extreme sensitivity of most modern miniature films, it is necessary to insert the film in the tank in complete darkness. This operation, however, is an extremely simple one and the method of doing so only has to be demonstrated once for the beginner to become immediately proficient. A small amount of practice with a length of old film will in any case easily enable the amateur to load up his tank in the dark. When film and celluloid band have been wound on the spool, and this has been placed in the tank, the lid is replaced and the tank is now ready to receive the developer. Before pouring in the developer, however, it is a sound precaution to fill the tank with water, to shake this up for a minute or so, and then to pour



TANK FOR LEICA FILMS. Fig. 1. Leica-Correx tank dismantled

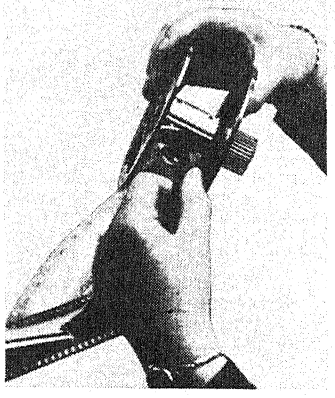


Fig. 2. Film and apron being fixed to spool



Fig. 3. Loaded spool is inserted in tank



Fig. 4. Developer is poured in

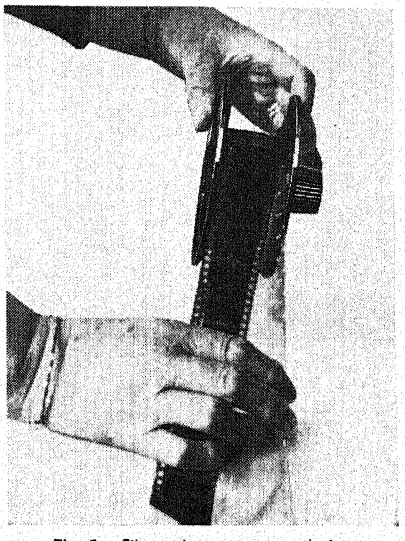


Fig. 5. Film and apron removed after development

the water off through the spout provided. This softens the emulsion, permits of better chemical action and obviates any possibility of the formation of air bubbles which will produce small clear spots on the finished film, and so spoil the result. The developer is then poured in.

Even Temperature Essential. For perfect results it is essential to have all solutions at an even temperature. Most developers on the market are recommended for use at a temperature ranging between 65° and 70° F.; but at whatever temperature a developer is to be used, it is essential to remember that this temperature should apply also to the fixing solution, rinsing and washing water, etc. It is also important to bear in mind that during the actual period of development, and later of fixing, the tank should be constantly agitated at given intervals of, say, one minute. In the case of the tank described, a special stirring knob is provided for this purpose. The stirring knob itself contains an aperture through which a thermometer may be passed to ascertain that the correct temperature is being maintained. It is, by the way, a useful feature of these new tanks, which are constructed of some composition material, that owing to their relative non-conductivity of heat, they are capable of maintaining the various solutions they contain at a fairly constant temperature over a period of several minutes.

Stop, Hardening, and Fixing Baths. At the expiration of the time required for development the developer is poured off into a bottle of coloured glass and kept for further use. It is now advisable before pouring in the fixing bath to treat the film with a solution designed to neutralize the alkalinity of the developer and at the same time to harden the emulsion of the film. This procedure will prevent the formation of pinholes or defects in the emulsion caused by the immediate reaction of the acid hypo with the developer remaining in the film. At the same time the emulsion is hardened in such a way that it becomes almost impervious to subsequent scratches. The use of this acid "stop bath" and hardener has, in addition, its effect on the final drying of the film which is shortened by the contraction of the gelatine layer to its minimum, thus expelling a certain amount of moisture. A formula for the acid stop bath and hardener found satisfactory is also very simple to make.

Formula for Stop Bath and Hardener

Sodium bisulphite	10 gms.
Chrome alum	10 gms.
Water	500 ccs.

The final solution required is the acid fixing bath consisting of the usual hypo-sulphite of soda plus potassium metabi-sulphite, or what, perhaps, is preferable a bath which provides for further hardening as well as fixing the film. For it is essential always to bear in mind that in miniature film development the ultimate ideal is to produce an absolutely flawless negative, and to this end no precaution should be neglected. The formula of this acid fixing and hardening bath is as follows:

Acid Fixing and Hardening Bath (Formula E.K. F-5)

Water (at about 135° F.)	600 ccs.
Hypo	240 gms.
Sodium sulphite (desiccated)	15 gms.
Acetic acid (28 per cent. pure)	47 ccs.
Boric acid crystals	7·5 gms.
Potassium alum	15 gms.
Cold water to make one litre.	

The film remains for a period of ten minutes in the fixing solution, which is afterwards discarded. Of all the solutions used the developer is, in fact, the only one which may be used on more than one occasion.

Washing. Fixing having been completed, washing is done with the lid of the tank removed. The best way for the washing to be effected is to allow a stream of water to run into the hollow core of the spool. Owing to the special construction of the tank and the spool core, the water then rinses the film from underneath and the whole film strip is thoroughly washed. The time taken for this washing should be not less than twenty minutes, although thirty minutes is to be preferred. It must be remembered that if the hypo of the fixing solution is not completely eliminated from the film, a very gradual chemical reaction will continue to take place after the film is dried and this will eventually affect the grain.

When the film has been thoroughly washed it must be removed with supreme care from the tank. The best method of doing this is to fix a clip at the end of the film and to draw it out, held taut with one hand, while carefully unwinding the spool with the other. The film is then suspended in an atmosphere which must be as dustproof as possible.

It is kept taut by a weight attached to the clip at the bottom end. Of course, it must on no account come into contact with any other object while drying.

With a scrupulously clean piece of chamois leather or a viscose sponge, both sides of the film are carefully wiped down in order to remove excess water. If this is not removed, " tearmarks " will be left behind when the small pools of water adhering to the surfaces dry off. For quick drying use an electric fan ; rather warm air is preferable.

It is essential to remember the basic fact that there are two main factors which affect the size of the grain in miniature film. These are the type of developer employed and the speed and scrupulousness with which all the processes associated with development are carried out. The speed with which the film is dried has, therefore, an important effect on the size of the grain, and this is very well illustrated by the fact that the negatives at the top end of a roll of film which has not been reversed half-way through the drying usually exhibit a finer grain than those at the bottom, which are normally the last to dry.

The method described, complicated though it may sound, is actually not so, and the precautions which have been underlined become absolutely mechanical and pass unnoticed after the process has been carried out a few times.

Multiple Development. The whole procedure, however, takes about an hour, and when, therefore, a large number of films are to be developed, as a result possibly of a holiday trip, it is suggested that the following arrangement be constructed for developing several films at a time. A number of spools complete with bands are obtained (these can be purchased separately) and a glass or stone jar of approximately the same diameter as the tank is also procured. The films are then wound on the spools and these are placed one above the other in the jar, which, of course, may be as tall as desired. In this way much time can be saved, although, of course, there is the additional expenditure to be reckoned with, as the spools complete with bands cost 13s. 6d. each.

Making Films Scratchproof. Latterly, having in mind the preservation of miniature negatives over an indefinite period from damage of practically any kind, a new product has become available. This is a preparation known as " Teitel's Scratchproof," which is diluted and used as a final bath after the films have been washed. The film is soaked in the scratchproof solution for about five minutes, and then hung up to dry as before. It dries with a glaze on the negative, making it difficult to distinguish the emulsion side from the glossy back of the film. A scratchproof-treated film is also stiffer and shows less tendency to curl than one that has not been treated in this way. It is impervious to almost all forms of violence. Attempts, for instance, to scratch it with the finger-nails have no effect.

Developing Miniature Plates. Several modern miniature cameras are now available for use with plates, among these are notably the Compass, Contaflex, Contax, Rolleiflex and Exakta ; although in most cases the use of plates is only an alternative to the use of films with the camera. In the case of plate development the procedure is extremely similar to the method already described, but instead of this special film tank another type of tank is used. This is a metal receptacle with a series of grooves in which the plates are held.

The use of plates in this way is a tremendous convenience where it is desired to make one or two exposures only and to develop them quickly, as in press work. At the present moment plates are not available with emulsions of so fine a grain as those which are provided for film users. The reason is chiefly one of demand. Miniature films are coated specially with their own fine-grain emulsions, whereas miniature plates are still cut up from large plates with comparatively coarse-grained emulsions. With the increasing use of plates, however, in miniature cameras, brought about by their steadily growing popularity among press photographers, this is a drawback that will undoubtedly very soon be overcome.

The Developer. The foregoing description of what is probably the simplest and most satisfactory method of developing miniature films has not dealt with the factor of the most vital importance, and that is the actual character of the developer itself. In the old days when a negative, say, of quarter-plate ($4\frac{1}{4} \times 3\frac{1}{4}$ in.) size had to be enlarged,

at the most about $3\frac{1}{2}$ times, giving a resultant enlargement of 15 × 12 in., the problem of grain hardly came into consideration. Nowadays, if we wish to make an enlargement of this size, we may be enlarging our original negative ten times. Formerly any ordinary pyro-soda or metol-hydroquinone developer would do very well, but those who would now employ such a developer for their miniature negatives must be prepared to sacrifice any possibility of making enlargements of reasonable dimensions.

There are a large number of excellent developers now on the market designed entirely with the object of preserving to the greatest possible degree the fine granular structure of modern miniature films. Roughly speaking, these developers fall into two groups : the " active " group represented by such types as Kodak D.76, buffered borax and Johnson's Fine Grain Developer, and the soft-working paraphenylene-diamine type of fine-grain developer embodied in numerous formulae and under various trade names. They are discussed in full in the section on Fine-Grain Developers, page 540.

DEVELOPING : (8) FINE-GRAIN DEVELOPMENT

In the following article, which is the eighth in the series dealing with Developing, Mr. A. L. M. Sowerby gives a clear explanation of the characteristics of Fine-Grain Development, a process that has been evolved largely to meet the needs of the miniature camera

Fine-grain development aims at producing a negative in which the grain structure of the image is as fine as possible. The need for this has arisen through the rapid increase in popularity of the miniature camera making tiny negatives which are expected to stand up to an enlargement of some 8 to 10 diameters at least without exhibiting noticeable grain. The even greater enlargement required from cinematograph negatives has also stimulated research in this field.

The need for fine-grain development is most particularly felt when using fast films, which are inherently more grainy than the slower ones. The latter will in many cases yield as fine a grain as is necessary for all normal purposes even if developed in ordinary —*i.e.* non-fine-grain—developers. This point is important, as a fast film developed for the finest grain requires a longer exposure than when developed normally. This exposure is sometimes no less than would have been needed for a slower film which, developed in a semi-fine-grain developer, would have yielded a negative of at least as fine a grain.

Fineness of grain in the finished negative has two aspects. Examination of a negative through a microscope will show the individual grains of which the image is composed, and it would naturally be supposed that the ideal would be to keep these as small as possible. But examination of a " grainy " enlargement shows that the defect of graininess produces an image that appears to be made up of a number of irregular dark specks, giving the whole an unpleasant mottled appearance. Since each grain—dark in the negative—would correspond to a light spot in the print, it is evident that it is chiefly the spaces between grains that cause graininess in the print. This therefore depends not so much on the size of the grains in the negative as upon their distribution ; if they clump together there will be produced the spaces that result in a grainy print, but if they can be persuaded to remain evenly distributed the granularity of the print will be much less, and will depend on the actual grain-size in the negative.

Fine-grain development consists in the use of a developer designed to control either the size of the grains, or their distribution, or more usually both. The two are in practice closely interconnected because the individual grains making up the image on the finished negative are themselves small " clumps " formed by the fusion, during development, of a number of particles that were distinct in the unexposed emulsion. This occurs because an exposed particle may " infect " those in contact with it, all then making one large grain in the developed negative.

The more energetic the developer used, and the longer the period during which it is allowed to act, the greater is the likelihood of this infection. A fine-grain developer is, therefore, gentle in its action, and in using it development is only allowed to proceed far enough to give a negative of quite moderate contrast, suitable for printing upon a paper of the " vigorous " rather than the " normal " or " soft " class.

The necessary gentleness is obtained partly by choice of developing agent and partly by keeping down to a minimum the alkali present, for this acts as an accelerator of the process of development. Borax, which is only very slightly alkaline, is therefore very commonly used in place of the usual carbonate, though in some developers, notably those sponsored by Messrs. Agfa, the necessary low alkalinity is obtained simply by reducing the amount of carbonate to a very low level.

Infection of unexposed grains is also reduced by making the concentration of sulphite high. This chemical tends to dissolve the grains of silver bromide in the emulsion, and by gently eating away their edges it prevents them from touching one another, and so discourages clumping.

The D76 developer, which resulted from research undertaken by the Eastman Kodak Co. of America, makes use of both these principles. It contains a very high proportion of sulphite and uses borax as the alkali. The formula of this developer is :

D76

Metol	2 gms.	17½ grs.
Sodium sulphite anhydrous	100 gms.	875 grs.
(or crystals)	200 gms.	1750 grs.
Hydroquinone	5 gms.	44 grs.
Borax	2 gms.	17½ grs.
Water to make	1 litre	20 ozs.

This developer is just energetic enough to bring out all the detail that an ordinary developer would give, and so does not demand that the film be given an exposure greater than the normal. The grain in negatives developed in it is as fine as can be obtained with any developer of this type and of equal energy. D76 has, therefore, been very widely adopted as a standard fine-grain formula, since its use in place of an ordinary developer gives a considerable improvement in grain with no compensating disadvantage.

Buffered Borax. Reduction of the energy of D76 can be effected in a number of ways, the most popular of which is the reduction of the alkalinity by the addition of 14 gms. (or 125 grs.) of boric acid to the formula given above. The resulting developer, widely known as "buffered borax," has very much less energy than D76, and in consequence gives a decidedly finer grain. But the low energy also results in an inability to develop up the weaker shadow detail, and to compensate for this it is necessary to give additional exposure up to as much as three times that required for a film that is to be developed in plain D76.

Many variations of this formula have been published from time to time, each either yielding results identical with those from D76 or making some different compromise between grain and effective film-speed. There is no magic in any of them ; with the addition of a suitable amount of boric acid, if required, D76 will duplicate exactly the results given by any other developer containing the same or equivalent constituents.

Paraphenylene-Diamine. For finer grain than can be given by D76 it is necessary to turn to a developing agent that is even less energetic in action than those commonly used in compounding ordinary developers. Paraphenylene-diamine has for some time been recognized as a developer of this type ; application to it of the principle of high sulphite concentration led Dr. Sease, at the laboratories of the American firm of Du Pont, to the four famous formulae that bear his name. These four form a series, the first containing paraphenylene-diamine and sulphite only, while the second, third, and fourth contain in addition a small, medium and large quantity of glycin.

Sease I

Paraphenylene-diamine ..	10 gms.	88 grs.
Sodium sulphite anhydrous	90 gms.	800 grs.
(or crystals)	180 gms.	1600 grs.
Water up to	1 litre	20 ozs.

This developer gives negatives in which the grain is extraordinarily fine and evenly distributed, allowing enlargements of very great size to be made without showing noticeable granularity.

It has also the extremely valuable property of preserving full gradation in the high-lights even when the film is very considerably over-exposed, or when the subject photographed contains a very wide range of contrast. This property is shared by all the paraphenylene-diamine developers, including Meritol, mentioned in this article, with the exception of the "compromise" developers containing metol.

It has, however, the very grave disadvantage that when used in conjunction with the fastest films it necessitates very considerable extra exposure, up to as much as six times with certain films. With the slower films the increase is in general less,

until with the ultra-fine-grain films of speed about 10/10 D.I.N. it is reported that no extra exposure at all is needed. The combination of one of these films with the Sease I developer gives negatives that are practically grain-free and permit of very great enlargement.

For all ordinary purposes, however, these slow films, and one or two of speed up to as much as 17/10 D.I.N., permit of as much enlargement as any ordinary camera-user is likely to require, even when developed in D76. A combination such as this is actually faster than a super-speed film of 21/10 D.I.N. developed in Sease I, for which purpose it has to be exposed as though its speed were about 14/10 D.I.N., and the best of the modern medium-speed films developed in D76 will give as fine a grain. The plain paraphenylene-diamine developer, although it has had its uses in the past, is of but little service to the modern photographer.

Sease Developers II to IV. The Sease II, Sease III and Sease IV developers are made by adding 1, 6, or 12 grammes (9, 55, or 110 grs.) respectively of glycin to the Sease I formula given above. Of these the particular compromise between film-speed and grain-size offered by the Sease III formula is by far the most popular. This developer gives, with the fastest films, a grain small and even enough for all everyday purposes, while the effective speed of the film is reduced only to one-half or one-third of the normal.

Many attempts have been made to remove the handicap of extra exposure imposed by the use of a paraphenylene-diamine-glycin developer without coarsening the grain. Most of these attempts have taken the form of adding more active developing agents such as metol, or of adding borax or sodium phosphate as an alkali to bring up shadow detail. Although reports are not always consistent, the general opinion seems to be that all such additions increase grain until it is no finer than could be had, for the same film-speed, from some version of D76.

Champlin 15. An exception to this, however, presents itself in a developer known, after its originator, as Champlin 15. The formula for this developer is copyright, and appears in the book " Champlin on Fine Grain," published by Camera Craft Publishing Co., San Francisco, by whose permission it is reproduced here. For full details reference should be made to Mr. Champlin's book. The formula is as follows :

Water	1 litre	20 ozs.
Pyrogallol	3·5 gms.	31 grs.
Sodium sulphite anhydrous	60 gms.	530 grs.
(or crystals)	120 gms.	1060 grs.
Benzoic acid	1·2 gms.	10½ grs.
Salicylic acid	0·5 gms.	4½ grs.
Boric acid	2·5 gms.	22 grs.
Tannic acid	1 gm.	9 grs.
Glycin	11·5 gms.	100 grs.
Paraphenylene-diamine	11.5 gms.	100 grs.
Isopropyl alcohol, 97 per cent.	50 ccs.	1 oz.
Nickel ammonium sulphate	1 gm.	9 grs.

The precipitate formed on the addition of the last ingredient must be filtered out.

It is claimed for this developer that it gives very fine grain and yet allows the film to be given not two or three times but *one-half* the exposure required in conjunction with D76. Independent reports do not confirm this latter claim, but there appears to be no doubt that Champlin 15 gives as fine a grain as Sease III, while requiring an exposure that is at most 1½ times that which would be required for development in D76. For the same grain the film thus has about twice the speed that it has when used in conjunction with Sease III.

Meritol. Another developing agent, which is an additional compound of paraphenylene-diamine sold under the trade name of " Meritol," gives results approximately identical with those obtained with Champlin 15. The formula for this developer is :

Meritol (Johnsons)	16 gms.	140 grs.
Sodium sulphite anhydrous	90 gms.	800 grs.
(or crystals)	180 gms.	1600 grs.
Water to	1 litre	20 ozs.

With the fastest films exposure has to be increased 1½ times as compared with that required for a film to be developed in D76, while the grain is of about the fineness of that yielded by Sease III, but not as fine as that given by plain paraphenylene-diamine in the Sease I formula.

Development Times. Suitable trial development times at 65° F. with the developers described in this article are :

Developer	Pan. 20/10	Ortho. 17/10	Pan. 16/10 D.I.N.
D76	12	10	8 minutes
Buffered Borax	24	20	16
Sease I	32	20	14
Sease III	17	12	9
Champlin 15*	12	9	7
Meritol	28	20	13

* At 73° F., which is the recommended temperature for this developer.

All these developers are used at the strength given, and must not be diluted for use in a tank. Well-bottled after use, each ½-litre (17 ozs.) will develop at least three 36-exposure films before it is exhausted. Time should be increased a little for films after the first development.

In conclusion it may be remarked that recent advances in emulsion-making have provided the photographer with films of inherently fine grain and quite high speed. The need for the more elaborate fine-grain developers requiring increased exposure is thus much less than it has been in the past, and if progress along these lines continues it may soon be found that even the fastest films provide as fine a grain as is necessary for all ordinary work with a simple M.Q. borax developer.

DEVELOPING: (9) PHYSICAL DEVELOPMENT

One form of fine-grain processing that has been the subject of much research is physical development. Here Mr. Stanley Bowler, A.R.P.S., explains the basic principles of this method, which has special qualities and important features

Dr. Allan F. Odell, whose death on April 9th, 1937, meant a great loss to photography, will probably best be remembered for his researches on the technique of this subject of physical development. His work, although principally carried out in the laboratory, has done much to simplify the procedure, and has brought this extremely interesting, and originally difficult, method of fine-grain processing within the scope of the amateur photographer.

In order fully to appreciate the basic principles of this system, it is necessary to deal briefly with the purely technical side of the question. Although what happens when light strikes a sensitive silver halide emulsion is not precisely known, the following assumptions allow of some theoretical explanation being given.

In chemical development the nuclei which have been light-struck are reduced to metallic silver in the emulsion by means of some reducing agent such as is found in ordinary developers, *i.e.* hydroquinone, metol, etc., etc. The granular structure of the image is therefore dependent in some considerable measure upon the original form of the particles in the emulsion. The colour of the image is quite different from that obtained by physical development, and generally varies from light grey to black. The black or denser parts of the image generally show what is commonly called " grain." While this rather loose term may serve its purpose in identifying an objectionable state of affairs, grain as such is not seen unless very high powers of magnification are used—far beyond that normally employed for enlargement on to paper. What is called " grain " is, in fact, the granular form of the image which is due to clumping of the smaller particles of the emulsion into uneven patches. The unevenness so formed becomes very noticeable when the image is enlarged. Modern fine-grain developers of the para-phenylene-diamine type tend to reduce this clumping to a minimum, and so give a finer " grain " when the image is enlarged. With suitable emulsions and such developers, enlargements up to 15 diameters should be possible at all times, without any trace of the structure of the image being visible.

Bearing this fact in mind, it will be appreciated that physical development is not necessarily a cure-all—its use should not be necessary on every and any occasion. It is only when really big enlargements are known to be required that this system of development can be shown to have very definite advantages over other and more usual methods. This statement may not always find favour with those who are definitely biased in favour of physical methods, but for the ordinary worker simplicity of procedure will generally be chosen in preference to the perfection that, perhaps, may be obtainable by other methods.

In physical development it is assumed, for the sake of simplicity, that the action is, perhaps, along the following lines. The nuclei which have been light-struck serve as centres of attraction for the deposition of metallic silver from a solution which contains a salt of silver together with a reducing agent. In this method it will be seen that the silver to form the image comes from without the emulsion, whereas in chemical development it is the silver in the emulsion itself which forms the image. The structure of the final image is, therefore, quite different from that obtained by chemical means, and

probably consists of a deposition of colloidal silver. The image is a surface image and of a very smooth character. The colour, for the same reason, is quite different and is generally a dirty yellow.

The procedure in physical development calls for considerable care and great cleanliness. It is still in the nature of a laboratory process in many ways ; this does not mean that it cannot be successfully carried out by the amateur, but simply that ordinary slip-shod methods will not do. Actually it calls for the same precision of working that should be given to all photographic processes, and those relating to miniature work particularly. It is probably to the miniature camera worker that this sytem of development will have the greatest appeal. Those who are particularly interested in the history of this subject may find many details of previous methods and difficulties surmounted in the literature on the subject which has been published in the past, but in this case our concern lies with a modern, simplified and practical method of considerable reliability.

Working Details. With the new methods it is possible to develop films or plates which are standing vertically in the tank instead of having to be laid out flat. In this way it is possible to develop miniature camera negatives in the ordinary commercial form of tank, employing either a spiral or an apron form of separator. There is one word of warning, however, and that is that any type of tank will not do—only those of bakelite, stainless steel or chromium plate should be used. Other metals attract the silver out of the solution, weakening the developer as the tank becomes plated with silver. All apparatus should preferably be cleaned chemically before use—for this purpose dilute nitric acid is ideal—and washed carefully after cleaning. Avoid touching any part with greasy fingers.

The film or plate to be developed must first be treated with a special fore-bath, the composition of which is given below. Previous to this the tank is filled with water to " wet-out " the film and ensure even action of all subsequent solutions, as is common practice with most workers. In tank development the fore-bath should be allowed at least three to four minutes (longer should not be necessary), while for tray or dish development the fore-bath should only need about 30 seconds for its action.

Fore-Bath Solution

Potassium iodide	80 grs.
Sodium sulphite, anhydrous	195 grs.
Water to make	16 ozs.

The solution should be used at full strength, and may serve for about six to seven films, if carefully stored in a brown glass bottle. Filter after preparing, and always filter the solution back into the bottle after use. Prepare with distilled water whenever possible. These last two remarks can be taken to apply to most photographic solutions where considerable accuracy is required.

After the fore-bath has been allowed to act, the film or plate should be washed for either two changes or, say, 30 seconds in running water.

For development, a stock silver solution is prepared at any time beforehand, as it is stated to keep well. The following quantities of chemicals are required, but contrary to usual practice the chemicals are not dissolved in the order given, but in the special manner about to be described.

Stock Silver Solution

Sodium thiosulphite, crystals (ordinary hypo)	2¾ ozs.
Sodium sulphite, anhydrous	1 oz.
Silver nitrate, crystals	120 grs.
Water to make	16 ozs.

The sodium sulphite is dissolved in about half the total quantity of water—*i.e.* 8 ozs., and the silver nitrate separately in about 4 ozs. of water. When the latter is completely dissolved it is added to the first solution and the whole stirred until the white precipitate which formed has completely dissolved. The hypo should now be added to the mixture, and the whole stirred as before till the solution is complete. Add whatever water is necessary to make up to the 16 ozs. specified. Filter into the storage bottle as has been mentioned previously.

The solution for developing should only be used once, and is prepared as follows :

> Of the stock silver solution, take 1 part, and add 4 parts of water, and to each 5 ozs. add 4 grs. of amidol. Thus, for 20 ozs. of developer, 4 ozs. of stock silver solution will be required, with 16 ozs. of water (preferably distilled), and 16 grs. of amidol. The whole should be stirred until complete solution takes place. If there is any doubt—and it is a good plan anyway—filter into a chemically clean vessel before putting the solution into the tank or dish.

Development should be complete in about 30 minutes at 65° F. *This temperature is important!* Various unwelcome changes take place if the temperature of the solution is allowed to rise above 70° F. Apart from this, it is always better to adhere to the exact working instructions wherever possible ; but in this case it is essential. Occasional agitation should be given to the tank during development. Before fixing, an intermediate washing should be given to remove the developer solutions. A normal acid-and-hardening-fixing bath may be used (an advantage as regards mechanical protection with miniature films) and fixation should be quite complete in about 15 to 20 minutes provided that a fresh and clean fixing-bath is used.

A final and thorough wash such as should normally be given completes the developing processes. If the film on removal from the tank shows a slight scum of silver, it should be swabbed down with a small pad of cotton-wool—for this reason alone the hardener in the fixing bath is a wise precaution—and the film is finally hung up to dry and the surplus water removed with a slit viscose sponge.

As will be seen, there is little in the foregoing to deter anyone from attempting this method of development. All that is needed is just that little extra care which marks the work of the serious amateur from the slip-shod dabbler. Any faults, either in this process or any other, can generally be traced to cheap and impure chemicals, careless preparation of the necessary solutions, or clumsy manipulation during processing.

DEVELOPING: (10) THE "INSTANTANEOUS" METHOD

Completing the long series of articles grouped under the main heading Developing, this article by Mr. F. J. Mortimer, Hon. F.R.P.S., deals with a method so rapid as to be almost instantaneous. Under certain conditions it can be employed with very good effect

A method of producing fully developed negatives in a minimum of time is described in this note, and before the theorist adversely criticizes the principle involved it should be given a practical trial. The only point that should be observed is that correct exposure is best for the most satisfactory results, as over-exposure is inclined to clog the negatives, but it is easily the ideal method for under-exposed plates or films. The method may be termed almost "instantaneous development."

Doubtless many workers have observed the effect of developing a correctly exposed bromide print with a strong developer of the Rodinal or Azol type. The image flashes up immediately all over the print, and if it is then fixed a flat grey result will be secured. If, however, development is permitted to continue it will be found that while the high-lights (a positive in this case) remain comparatively unchanged, the shadows will grow darker until full strength is secured.

The same principle can be applied to the development of a negative by using a highly concentrated developer, and by allowing it to act for a comparatively short time only. Experiments conducted in the past have demonstrated the perfect feasibility of this method, and highly successful results have been obtained by its use. For those who wish to try it for themselves an ordinary spool of film should be correctly exposed in the camera, and the following procedure adopted for developing :

In the dark-room four fairly deep dishes should be set out : (1) plain water ; (2) highly concentrated developer ; (3) plain water, and (4) a strong acid hypo fixing bath.

In practice the film, after being removed from its spool (and, of course, kept isolated from direct rays of the dark-room light), is first passed through the dish of plain water, see-saw fashion, until it is limp. It is then passed through the concentrated developer for a very short time, which is determined by the strength of the solution itself. This may be a few seconds, or at the most a quarter of a minute. It is then passed through the water in the third dish, once, to clear off the surface developer, and plunged straight into the fixing bath to stop all further developing action. The entire process need not occupy more than a few seconds.

Developers. The developer to employ for this work should be of the Rodinal or Azol type, or the following formula may be employed.

Rapid or Instantaneous Development

Paraminophenol hydrochlorate ..	1 oz.
Potassium metabisulphite	3 ozs.
Hot water	10 ozs.

When the above ingredients are dissolved, add strong caustic potash solution (30 per

cent.) until the precipitate first formed is *almost* but not quite dissolved and the solution is practically clear. The caustic should be added slowly with constant stirring. This forms the concentrated developer. (For ordinary development it is diluted with from 10 to 60 parts of water.)

If it is desired to keep the developing process down to a matter of two or three seconds, the developer (either Rodinal, Azol, or the above solution) can be used " neat," or at the most diluted with only one part of water, but in no case should it be diluted with more than four parts of water, in which case the developing action may take 10 or 12 seconds instead of one or two. The excellent quality of the negatives produced by this method will have to be seen to be believed ; there is no clogging of the high-lights, and every possible detail appears in the shadows. There is no fogging, and provided the exposure has been correct, or nearly so, there will be no fault to find with the quality of the negatives in regard to tone contrast or grain throughout the complete range.

Here it will be seen that the action has been to develop the image immediately over the entire surface of the exposed film. If the action were allowed to continue, even for a few seconds longer, in the highly concentrated developer, the high-lights would gain extra density very rapidly, and if development were still further continued they would clog up and there would be no gain over the ordinary procedure. By using the concentrated solution and restricting its action, a method of dealing with a large number of exposures is indicated that will appeal to innumerable workers, to whom time is a matter of importance for dark-room work.

Incidentally, the concentrated developer should be bottled again immediately after use and can be used over again both for negatives and prints.

DEVELOPMENT: (1) THE SCIENTIFIC BASIS

H. H. Baines, D.Sc. (Lond.), F.I.C., F.R.P.S.

This is the first of two articles dealing with the general theory of development which is accepted today. After describing the constituents of negative developing solutions and their properties, the author goes on to explain their function and to discuss the basic aspects of the subject. For information on paper development the reader is referred to the headings Bromide Printing ; Gaslight Paper, Prints, Density and Tonal Values

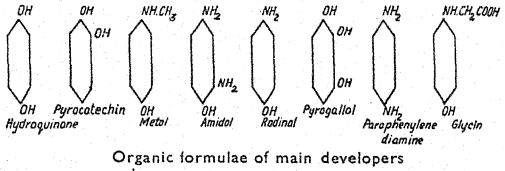
See also Contrast ; Negative, Density and Tonal Values

If silver bromide—the light-sensitive constituent of photographic materials—is exposed to light, it decomposes into bromine and metallic silver, the presence of the latter causing the compound to darken in colour. It was discovered by Fox-Talbot in 1840 that if paper treated with a silver salt were slightly darkened by light-action and then treated with a solution of silver nitrate and gallic acid, the exposed portions were coated with metallic silver in relation to the original exposure. In this way light was made to initiate the darkening, and a subsequent process—development—to produce the bulk of the silver which is responsible for the blackening.

This general process is still used today, methods of development being divided roughly into two classes. By one method, known as ***chemical development,*** the silver of the image is obtained by decomposition of the silver salt of the sensitive material. By the other method, called ***physical development,*** the developing solution contains a silver salt in solution, and this is the source, by deposition, of the image silver. Physical development is so little used nowadays that it need not here be considered further, beyond stating that it gives generally a much more grainless image than chemical development. (It is considered in some detail in its own section, page 571.) Modern chemical development has improved since Fox-Talbot's time to such an extent that it is now unnecessary to expose sufficiently to produce slight visible darkening before development will take place—the necessary exposure to light is so small that there is no visible change in the silver salt.

Modern photographic materials consist of minute crystals of silver bromide (with a small proportion of silver iodide) embedded in a thin gelatine layer which has been coated on glass, film or paper. Although a large number of chemical reducing substances will convert the silver bromide into metallic

silver, the presence of gelatine impedes this conversion, and a certain class of reducing compounds known as " developers " which would easily reduce massive silver bromide to silver just fail to do so when it is dispersed in gelatine. This protective action of gelatine may be overcome in a number of ways. Long time of action, or high temperature of the developer, excessive pressure on the photographic material, or—and this is of paramount importance in photographic practice—a slight exposure to light, will each cause the silver bromide to be reduced by the developer, giving black metallic silver. The compounds which have been found most effective as photographic developers are generally amino or hydroxy derivatives of benzene. The formulae of some of the more common developing agents are appended :



Organic formulae of main developers

Generally, the more nearly these reducing agents overcome the inhibiting action of the gelatine, the more sensitive or more vigorous are the developers made therefrom.

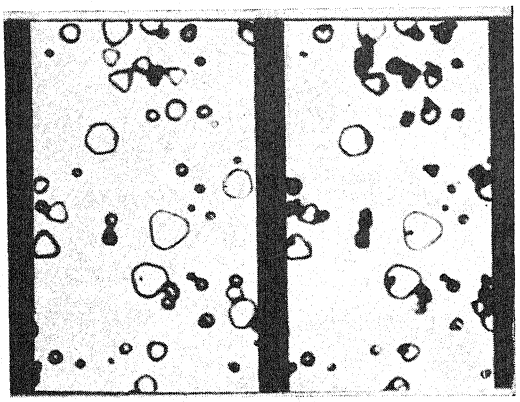
Constituents of a Developing Solution. Developing agents are generally mildly acidic in character, and are much more active as reducing agents when present in solution in the form of their alkali salts. Thus while in plain aqueous solution they may partially develop a normally exposed material in several hours, the presence of an alkali such as sodium carbonate would reduce the time of development to a few minutes.

For this reason, an alkali such as sodium carbonate (pure washing soda), caustic soda, borax, ammonia, etc., is an essential constituent of nearly all developers, and is known as the *accelerator*. The energy of a developing solution will depend, *inter alia*, upon the nature and concentration of the accelerator. A plain solution of developing agent and sodium carbonate may be improved upon as a developer by two further additions. In the first place, it has an affinity not only for the bromine of silver bromide but also for oxygen of the air, with the result that exposure to air causes rapid discoloration and exhaustion of the developing agent, with consequent decrease in activity. This defect may be eliminated by incorporating in the solution a constituent known as the *preservative*, which should have a greater affinity for atmospheric oxygen than the developing agent, but should *not reduce silver bromide*. The compound which fulfils this function admirably is sodium sulphite, and hence it is a constituent of practically all developers. It prevents aerial oxidization of the developer by itself preferentially combining with the dissolved oxygen, and its inertness towards silver bromide ensures non-interference with normal development.

When the alkali salt of a developing agent reduces silver bromide, the resulting products, in addition to metallic silver, are alkali bromide and an oxidization product of the developing agent. Generally all chemical reactions are slowed down by the presence in the system of the end products of a reaction, and if the concentration of the end products are high the reaction may be stopped or even reversed. In photographic development the presence of one of the end products, alkali bromide, thus retards the developing action. Indeed, when a developer is " exhausted " this is due in many cases not so much to the fact that the developing agents have been used up, as to the fact that the solution has ceased to function owing to the retarding effect of the accumulated alkali bromide. In the entire absence of soluble bromide, however, many developing solutions are too active to be controllable, and unexposed grains are likely to be reduced, with consequent production of " chemical fog." This excessive activity is eliminated by the addition of a small concentration of potassium bromide, which thus functions as a *restrainer*.

Summarizing, a developer consists of the *developing agent*, an organic compound, or mixture of compounds, usually fairly simple derivatives of benzene ; an *accelerator* consisting of an alkali such as sodium carbonate, a *preservative*, sodium sulphite, and a small quantity of potassium bromide as a *restrainer*.

The Mechanism of Development. Little is known with certainty of the mechanism of light-action on silver bromide, but if the course of development of exposed silver bromide grains is watched under the



DEVELOPMENT. Fig. 1. Photomicrograph of silver bromide grains at two stages of development. Note how development begins at " development centres "

microscope, it is found that after an induction period (partly occupied by the developer soaking into the gelatine film) development commences at one or more points on the surface and spreads therefrom throughout the grain. Development does not spread from one grain to a neighbouring unexposed grain unless the two are in contact. These points from which development commences are called " development centres," and have been the subject of much experiment and postulation. It is now considered that on the surface of the unexposed grain are specks of some substance other than silver bromide (perhaps silver sulphide or metallic silver) which are extremely small in relation to the minute silver bromide grains. These specks are more sensitive to light than the surrounding silver bromide and are known as " sensitive nuclei." On exposure some change in the nuclei takes place, which converts them into development centres from which development will spread through any silver bromide in immediate contact. The development of grains is illustrated in Fig. 1, and the mechanism of light-action and development is shown diagrammatically in Fig. 2.

Development and Graininess. Obviously as the process of development proceeds the amount of blackening produced by any one uniform exposure will increase, largely because more and more grains become developed with time of action, but also because any one grain will be more completely developed at longer development times. The former factor is by far the more important as generally the time taken for any one grain to develop, once development has commenced, is short compared with the total development time. However, the second factor—degree of development of each grain—will influence the graininess of the image to this extent, that the grain size of the particle of silver produced from each grain will increase with increasing development time, and thus graininess will increase as development is prolonged.

There are, however, other effects which have a more important influence on graininess in the same direction. The grains of an emulsion vary in size, the largest being generally the most sensitive. Let us consider two silver images of the same optical density (or blackness), one of which has been produced by a short exposure and full development, and the other by short development of an appropriately long exposure. In the first case the short exposure has rendered developable only the most sensitive (*i.e.* largest) grains, and after full development these constitute the image.

In the second case the full exposure has rendered developable not only the largest grains but also numbers of the smaller, less sensitive, grains. Developer shows no preference for the larger grains and hence after a short time of action the image consists of grains of much less average size than in the first case considered; *graininess at equal densities increases with development time.*

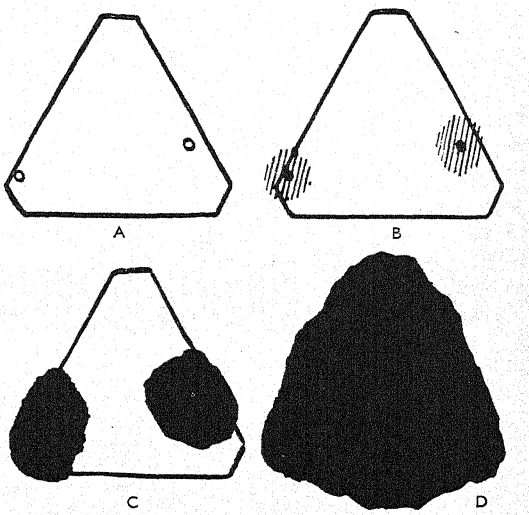
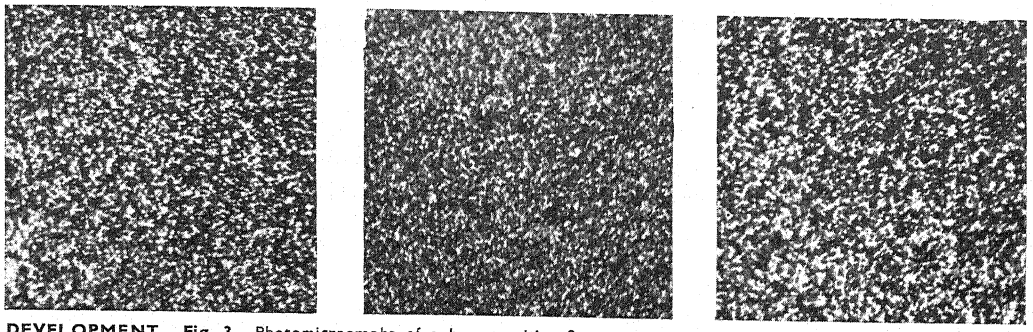


Fig. 2. Diagram showing the mechanism of light-action and development. (A) Unexposed silver halide grain showing undevelopable sensitive nuclei; (B) Exposed silver halide grain, showing silver deposit on sensitive nuclei (developable). Reaction product of bromine and gelatine shown shaded. (C) Development spreading from the centres. (D) Grain of spongy silver after development



DEVELOPMENT. Fig. 3. Photomicrographs of a hypersensitive fine-grain panchromatic film after being developed to the same contrast with three different types of developer. In the left square, borax-M.Q., was used ; for the centre square, glycin paraphenylene-diamine was employed ; while the result shown at the right was obtained by using M.Q.

This increase in graininess of the image is of little importance when contact printing, as the largest grains or clumps of grains are too small to be distinguished by the unaided eye, and the tones appear as continuous shades of grey, just as a medium shade is obtained from a large number of black dots in the half-tone process. In the case of negative material which is intended for considerable enlargement, as, for example, cine film or film for miniature camera work, the grain patterns are liable to show when magnified to the extent usual in practice, and it is essential to keep the grain as fine as possible. This is done in two ways. In the first place the photographic material is made so as to possess very small grains of silver bromide, which give a correspondingly fine-grained silver image, and, secondly, development is adjusted to give fine grain.

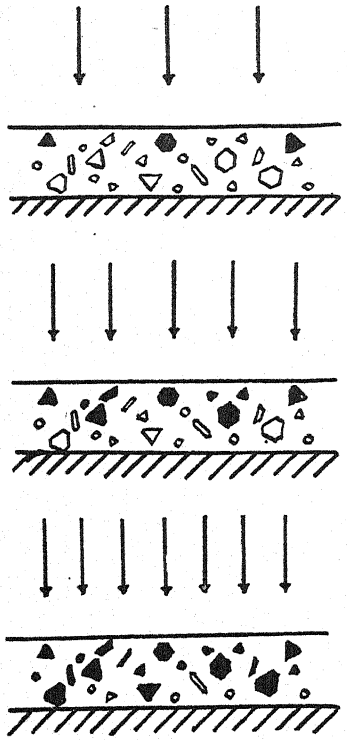
Modern fine-grain developers work on the principle of using a slow-working, less vigorous developer in conjunction with a high concentration of sodium sulphite, which exerts a mild solvent action on silver bromide. The dissolved silver bromide is reduced in solution and deposited in a less grainy form, and thus the developing action of fine-grain developers may be considered as a combination of " physical " and " chemical " developments. The slower developing action may be obtained by the use of developing agents of suitable characteristics, as, for example, " glycin " or paraphenylene-diamine, or by using one of the usual types of developer with effectively less accelerator present. In either case, development is kept to a minimum degree (which in itself reduces graininess) in a convenient and controllable manner, but even at the same degree of development as judged by contrast (*see* later), developers of this type give a definitely finer grain than normal M.Q. In these circumstances, however, the developers usually cause an effective loss of speed.

The formulae of typical normal—borax type—and true fine-grain developers are appended, and Fig. 3 shows photomicrographs of the same density on a typical Leica film, obtained in all three developers when developed to the same contrast.

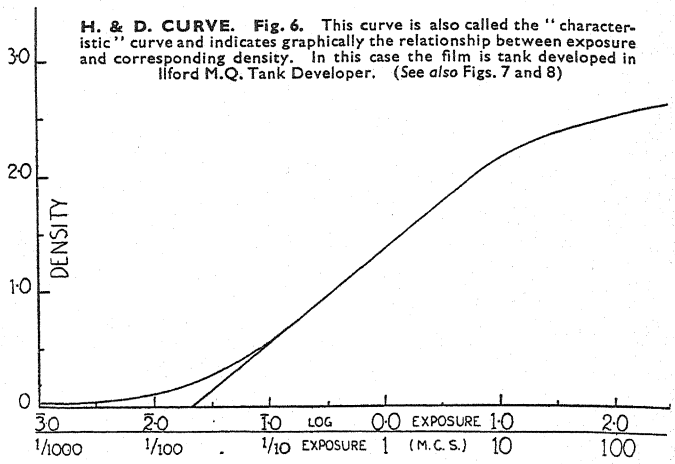
	Normal M.Q.	Borax M.Q.	Sease III
Metol	1 gm.	3 gm.	—
Hydroquinone ..	4 gm.	7.5 gm.	—
Glycin	—	—	9 gm.
Paraphenylene-diamine	—	—	15 gm.
Sodium sulphite (cryst.)	75 gm.	300 gm.	270 gm.
Sodium carbonate (cryst.) ..	50 gm.	—	—
Borax	—	3 gm.	—
Potassium Bromide	1 gm.	—	—
Water to	1500 cc.	1500 cc.	1500 cc.

When the grains of silver bromide are reduced to metallic silver during development, the latter is deposited in a spongy, amorphous state, which under the microscope is very different in appearance from the familiar shiny metal (crystalline form). The silver, like the silver bromide from which it was formed, is present in the image as an enormous number of minute particles.

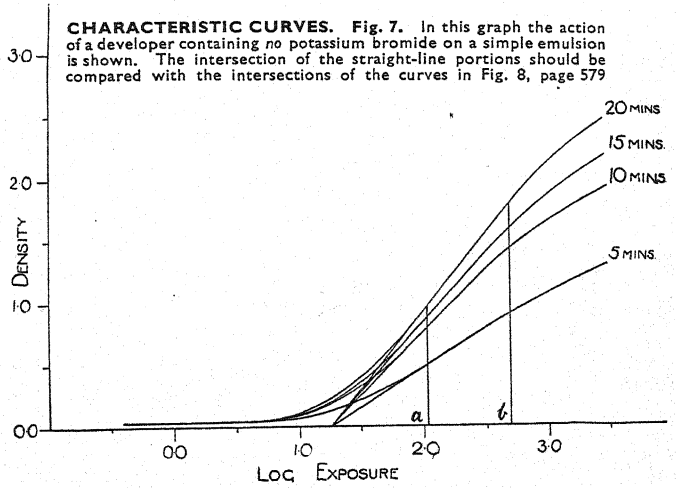
When a photographic plate receives a weak exposure to light, only the most sensitive grains (usually the largest) on the surface are made developable. As exposure increases, the less sensitive grains near the surface and the more sensitive grains in the lower layers become progressively developable until



CROSS SECTION OF EMULSION. Fig. 4. After exposure some of the grains in the emulsion on a film or plate become developable. In the diagram the developable grains are blacked out to represent the silver image on an actual film. The top diagram indicates light exposure, the centre medium, and the bottom heavy



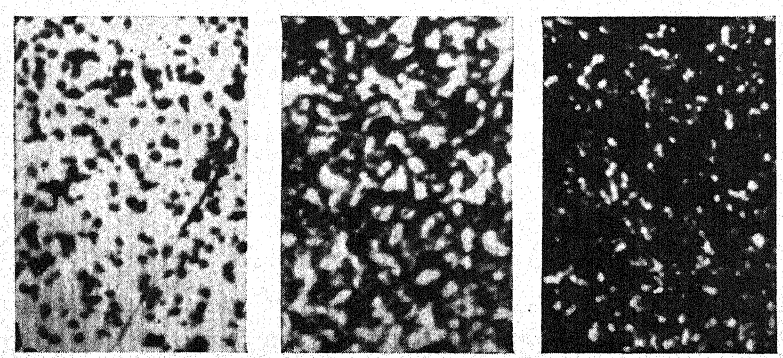
H. & D. CURVE. Fig. 6. This curve is also called the "characteristic" curve and indicates graphically the relationship between exposure and corresponding density. In this case the film is tank developed in Ilford M.Q. Tank Developer. (*See also* Figs. 7 and 8)



CHARACTERISTIC CURVES. Fig. 7. In this graph the action of a developer containing *no* potassium bromide on a simple emulsion is shown. The intersection of the straight-line portions should be compared with the intersections of the curves in Fig. 8, page 579

finally nearly all the grains in the film are rendered developable. This is illustrated diagrammatically in Fig. 4, which represents the cross section of an emulsion which has received various exposures.

Photomicrographs showing the silver images resulting from light, medium and heavy exposures are shown in Fig. 5.

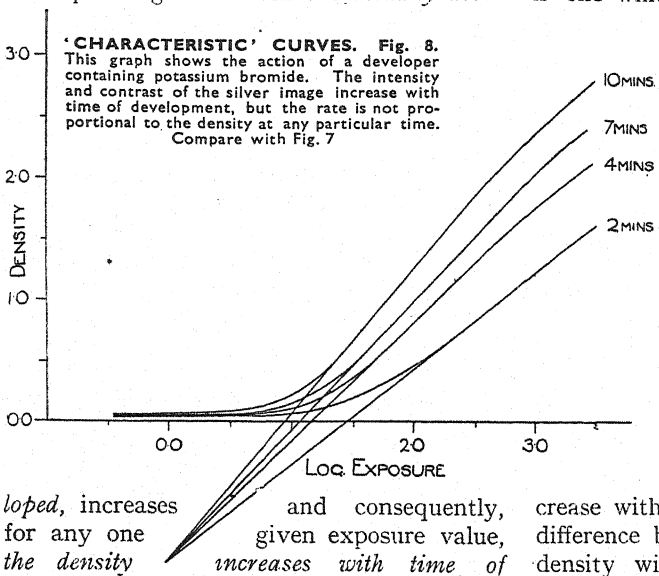


EXPOSED EMULSION. Fig. 5. This photomicrograph shows the silver images on exposed film magnified 500 times. On the left is a light exposure; the centre, medium; and the right, heavy

It will be seen that as exposure increases so the number of silver grains, and consequently the blackness or "density," increases (under constant development conditions), and it is shown elsewhere in this Encyclopedia (*see* Negative, Density and Tonal Values) that the relation between the exposure and the corresponding density may be expressed graphically by the familiar H. & D., or "characteristic" curve (Fig. 6). Compare Figs. 6, 7 and 8.

Now let us see how development affects the characteristic curve. Any one uniform

exposure renders a certain proportion of the total number of grains developable by a particular developer. As development time increases from zero the number of developable grains which are *actually developed*, increases and consequently, for any one given exposure value, *the density increases with time of development* up to the time when all the developable grains are developed. If development be prolonged beyond this time, unexposed grains will be attacked and chemical fog will result.



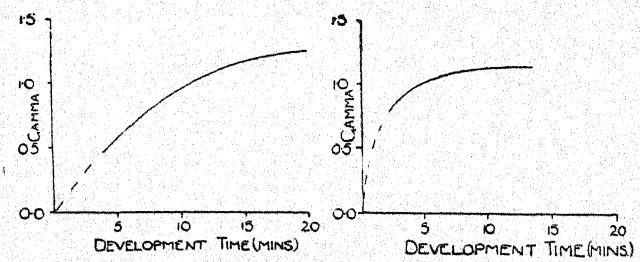
'CHARACTERISTIC' CURVES. Fig. 8. This graph shows the action of a developer containing potassium bromide. The intensity and contrast of the silver image increase with time of development, but the rate is not proportional to the density at any particular time. Compare with Fig. 7

When using certain developers which contain no potassium bromide, the characteristics of a simple emulsion at various times of development are represented by a group of characteristic curves whose straight line portions intersect on the log. E axis, as shown in Fig. 7. If we consider the growth of density with time of development at any two exposures, " a " and " b " (Fig. 7), we find that when exposure " a " has developed half its full density, so has " b," and so on for all fractions. That is to say, *the rate of increase of density during development is truly proportional to the density at any one time of development.*

Now, by the term " contrast " a photographer means the rate of increase of density with increasing log. exposure, *i.e.* contrast may be expressed on the characteristic curve as the rate of vertical rise (density) with horizontal shift (log. E), or as the *slope* of the straight line portion. This is designated as " Gamma " (γ) (*see* Gamma). It will be seen that as development increases, so the Gamma or contrast of the negative increases, and a correctly developed negative is one which has been developed for the necessary time to give the correct contrast. The latter will depend upon the subject, the printing paper, and the effect desired, but for average subjects printed on a certain grade of paper, a fixed predetermined degree of development (*i.e.* fixed time and temperature in a developer of certain composition) gives a negative of optimal characteristics.

A developer containing potassium bromide behaves qualitatively in accordance with the above description, namely, both density and contrast increase with time of development, the main difference being that the rate of increase of density with time of development is not quite proportional to the density at any one development time. That is to say, the straight line portions of the characteristic curves obtained at different times of development do not intersect on the log. E axis. They intersect at a point below this as shown in Fig. 8.

The distance of the point of intersection below the log. E axis depends on the concentration of the potassium bromide, and also on the developing agent used, the depression of the intersection point being less with a powerful developing agent than with a weak one. As a matter of fact the amount of depression produced by a constant amount of potassium bromide is a measure of the energy (reduction potential) of a developing agent.



Figs. 9 and 10. " Gamma time-curves " showing characteristics of different development systems. Left, curve indicating initial " hanging back " and gradual building up of the image Right, curve showing rapid building up of image

The manner in which density and contrast build up during development is a consideration of some importance to the practical photographer. It depends on the sensitive material and on the developer used, and can be expressed graphically by plotting the Gamma produced against the corresponding development time. Thus Figs. 9 and 10 show " Gamma-time curves " derived from the groups of curves shown in Figs. 7 and 8.

It is at once apparent from the different shapes of the two curves that the development characteristics of the two systems represented are very different. The system shown in Fig. 10 is characterized by rapid building up of the image, but after a short time, development is virtually complete; while in the other case (Fig. 9) the image " hangs back " at first, but then gradually builds up to a higher contrast than that shown in Fig. 10.

Temperature of Development. In all of the above-mentioned considerations concerning time of development, constant temperature has, of course, been assumed, since variation in temperature affects the degree of development. Over a certain range, however, temperature variation alters merely the *rate* of development, more rapid development being obtained at higher temperatures. To obtain a certain desired contrast with any particular developer at 70° or 60° F., it is therefore merely necessary appropriately to decrease or increase (respectively) the time which gives the desired contrast at 65° F. The ratio of alteration of time development for a given temperature difference varies with different developers, but generally one third decrease in the development time per 10° F. increase will give approximately the same result.

Development Methods. *(a)* Development by Inspection. A roughly approximate idea of the correct amount of development which any material should receive may be obtained by periodic examination of the negative by safelight during development. The method is of limited application, and has little to recommend it. Panchromatic materials cannot generally be so treated, and the risk of fogging other types of sensitive goods is not inconsiderable. Moreover, judgement in very dim illumination of an unfixed plate or film is apt to be inaccurate. The method doubtless owed some of its past popularity to the belief that errors in exposure could be corrected by adjustment of time of development. Actually, in some cases partial compensation for small errors is possible, but errors of any magnitude cannot be corrected, and the inspection method offers no real advantage from this point of view.

(b) Development by Standard Time and Temperature. It has been shown that a correctly developed negative is one which has been developed to give a certain contrast, and that any required degree of contrast may be obtained by adjusting the time and temperature of development to the required values. These values must be predetermined, and in practice the photographer is relieved of the task by the manufacturer of the sensitive material, who recommends not only the most suitable developer but also the time and temperature which give optimal results. Actually even when these are controlled some variation in contrast is possible depending on the degree of agitation of the material during development, but in practice the error introduced is for ordinary purposes small. This method of development control is probably the simplest and most accurate.

(c) Factorial Development. Development by standardized time and temperature depends upon the fact that for any particular normal material and developer a certain contrast always corresponds to the same time and temperature of treatment. Suppose that we make experimental observations of the times required to give two particular contrasts : *(a)* the desired contrast and *(b)* minimum perceptible contrast, *i.e.* just greater than zero. (We cannot see an image unless there is some degree of contrast there, so that minimum perceptible contrast will obtain at the moment of appearance of a portion of the image—the high-lights.) Let the two times be t and t_0 respectively. Then when using this material and developer a method of obtaining the correct degree of contrast would be to time the first appearance of the image, multiply by the factor $\frac{t}{t_0}$ and develop for the resulting time obtained. It was found experimentally that this factor $\frac{t}{t_0}$ known as the Watkins factor, is largely independent of the dilution of the developer

and even of the photographic material, but depends upon the proportion of bromide and the developing agent, being higher with developers of greater energy (higher " reduction potential "). Factorial development lacks the accuracy and simplicity of the standardized time-temperature method, but may be used with advantage when insufficient data on the development characteristics of a material are available. In order to obtain a Gamma of approximately 1·0, it is necessary merely to time the first appearance of the high-lights, the required duration of development being obtained by multiplying this time by the Watkins factor of the particular developing agent used.

The Watkins factors for a number of common developing agents are as follow:

Metol	30
Hydroquinone (with bromide)	5
M.Q.	14
Amidol	10
Paraminophenol	16

It may be emphasized that consideration of development conditions is of real use *only* if the correct exposure has been given, and since development is capable of accurate control, it is foolish to rely on guesswork.

DEVELOPMENT: (2) THE THEORY APPLIED

W. L. F. Wastell, Hon. F.R.P.S.

The application of the basic principles of development forms the subject of this article from a leading figure in the photographic world. With examples and illustrations it interprets simply the scientific theory presented in the previous chapter. In addition to negative development the author also touches upon various aspects of paper developing

See also Contrast ; Negative, Density and Tonal Values

Of several varied forms of development the most important is that which results in the production of negatives. It is the very foundation of almost all forms of photography, and is therefore of major importance. The theory and practice of development have been fully dealt with in various aspects, but it may be well to run over some of the fundamental facts so that they may be understood even by the novice, who cannot hope to work intelligently and satisfactorily without some knowledge of principles as well as of practice.

In the earlier days of photography development, whether of wet or of dry plates, was mainly directed to the production of negatives suitable for making prints on albumen paper. This simplified matters. Today, not only the choice of sensitive material but the character of negatives is a very complicated matter. So varied are the purposes for which negatives are required that the negatives themselves accordingly vary enormously in character, and development is one of the important factors that brings about this variation.

It is a necessary corollary that no single negative can be equally suitable for all purposes. The more perfectly a negative is adapted for one particular purpose the less satisfactory it may be for another. On the other hand, a negative may be of such a character and quality that it will serve several purposes equally well. Therefore the photographer must understand the different characters of negatives, and to what extent these are affected by development.

Starting with a very simple case, with the aid of Fig. 1 (p. 582): at the top is a diagrammatic representation of six strips of paper, black on the left, white on the right, with four strips of graduated greys between. An exposure on such a subject will result in greatest light-action for the white strip, less for the next, and so on, till there may be none at all for the black strip.

When the plate is developed the first deposit of silver will appear for the sixth strip, next will appear the fifth strip, and so on : each strip having the start of the one next to it and maintaining it till the end. There will then be strips of different densities on the negative, and these may be suggested graphically as a flight of steps. The lower flight represents the densities after a certain development time, the upper after a longer time. There are the same successive rises representing the different tints, but in one set all the densities are greater than in the other.

In the bottom diagram the height of each

step is shown by a vertical line, and the dotted line shows the increase in density from black through regular gradations of grey to white.

Suppose now we have a much greater range of degrees of light-action on the plate, resulting in a greater variety of densities in the negative. Each of these densities could be measured and shown graphically by plotting out points and joining them to form a continuous line. This would give something of the kind shown in Fig. 2. The dots showing the lowest densities and those showing the highest densities would probably produce a slight curve, while between the two curves would be a straight line representing the intermediate densities. Such a line in its entirety is called the " characteristic curve " of the plate, and is more fully described under the heading Curve.

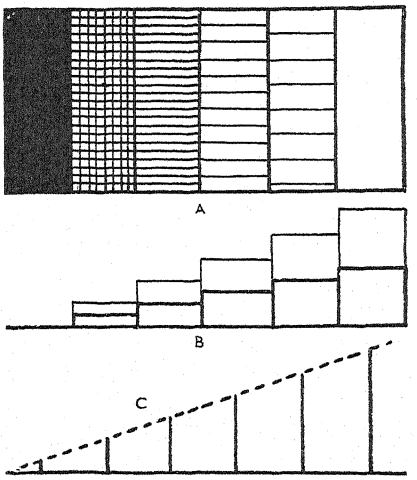


Fig. 1. Basis of graph showing degrees of density with suggested parallel of a flight of steps (see p. 581)

Fig. 3 is another graph. The divisions along the line AB represent different degrees of light-action, each succeeding one being twice as great as the one before it. The rising steps show the increasing densities of the silver deposits in relation to the line AC. It will be seen that, starting from A, the slight light-actions do not have a proportionate effect on the densities. They hang fire. But somewhere about the point D each increase in density begins to correspond exactly and regularly to each proportionate increase in light-action. After a time, somewhere about E, the densities begin to become less in proportion to the light-action, until at last no further increase in density is possible. The dotted line shows the extent to which the " curve " deviates from the straight at both ends—"under-exposure " from A to D, and " over-exposure " from E onwards.

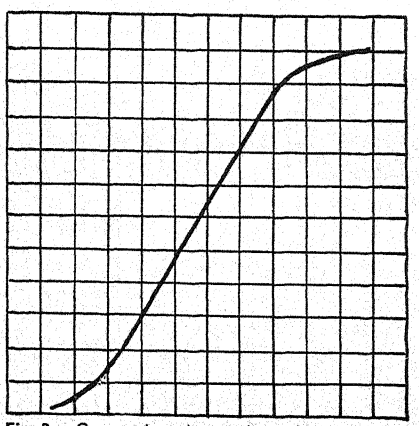


Fig. 2. Curve plotted to show densities in a negative. The line is the " characteristic curve "

Naturally the different " strengths " of the silver deposits in the negative govern the amount of light that will pass through them. The fraction of light that is stopped by the deposit indicates its *opacity* ; the fraction of light that is passed by the deposit indicates its *transparency*. The denser the deposit the greater the opacity ; the lighter the deposit the greater the transparency ; and it is evident that there must be a definite relation between the two.

Thus, if the silver deposit lets half the light through, the transparency is half and the opacity is two. We may set down some examples :

Transparency	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{10}$	etc.
Opacity	2	4	8	10	etc.

It will be noted that the denominator of the transparency fraction gives the opacity figure.

We may now take some sample opacities and show the corresponding densities :

Opacity	1	2	4	8	10	20	100	1000
Density	0	0·3	0·6	0·9	1	1·3	2	3

The figures for density are the logarithms of the opacity numbers, and are used for convenience, and to keep our graphs within bounds. For the same reason we use logarithms of the exposures.

It will be seen that the *density* represented by 1 is equal to an *opacity* of 10, and that this opacity has a *transparency* of 1/10th. That is to say, a density of 1 allows only 1/10th of the light to pass. A density of 2 passes 1/100th of the light, and a density of 3 passes only 1/1000th.

If we now look back at Fig. 1 we see that longer exposure increases

contrast. The word indicates the difference between the lightest deposit of silver and the heaviest.

It is possible to give only a vague idea of the character of a negative by means of a half-tone block, but Fig. 4 suggests a negative that has not been sufficiently developed. Much of it is clear gelatine, and the deepest deposit of silver is a light grey.

Fig. 5 shows the difference when development has been continued longer. There is more detail in the shadow portions, and there are heavier deposits of silver elsewhere.

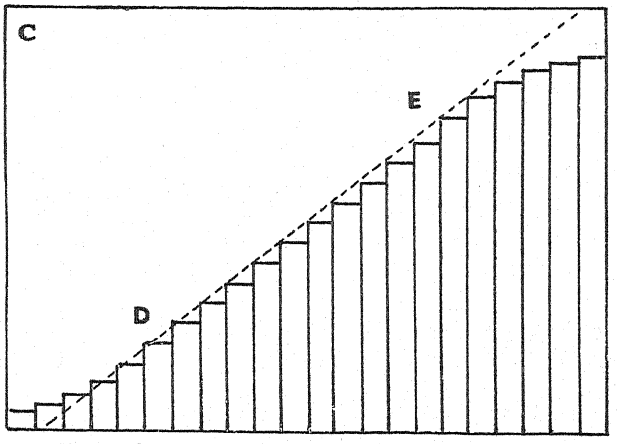


Fig. 3. Graph showing proportions of density to light-action. Divisions along AB represent degrees of light-action, and rising steps indicate densities of silver deposits in relation to line AC

In Fig. 6 development has been even more prolonged ; clear gelatine is absent except in the very deepest shadows, and there are densities great enough to give bright high-lights in a print made from it.

Owing to different development times the first negative has low or weak contrast ; the third has high or strong contrast. Suppose we say that a plate will give 20 gradations of density, and put 1 for the faintest deposit we can detect and 20 for the densest deposit the plate will give. Then we might say that the first negative ranges from 1 to 5, the second from 1 to 10 and the third from 1 to 20.

The first negative is a warning that under-development may be fatal. If development has not been sufficient to bring out the necessary shadow detail, nothing can be done to remedy the defect. We can strengthen densities that are too weak for our purpose, but no printing process can possibly produce more gradations than are present in the negative, nor can prolonged development introduce missing detail.

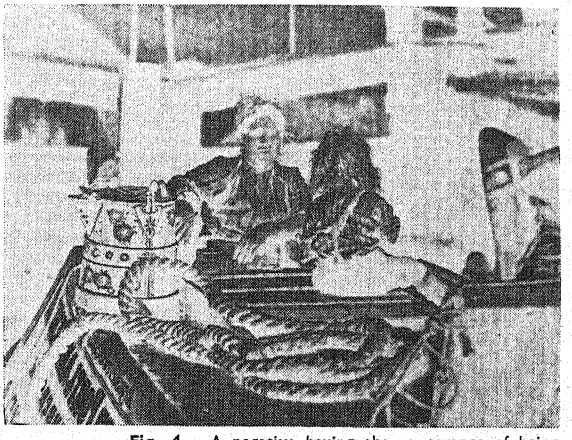


Fig. 4. A negative having the appearance of being under-developed

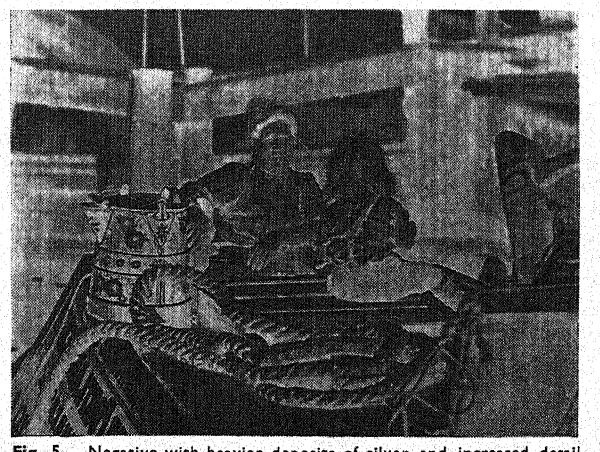


Fig. 5. Negative with heavier deposits of silver and increased detail resulting from longer development

The extreme degree of density that can be obtained in a negative depends partly on the character of the sensitive material, partly on the time of development, and also to a considerable extent on exposure.

And it must be remembered that density and contrast are two different things, and that density does not affect contrast necessarily. We may consider the case of negatives that have received different exposures

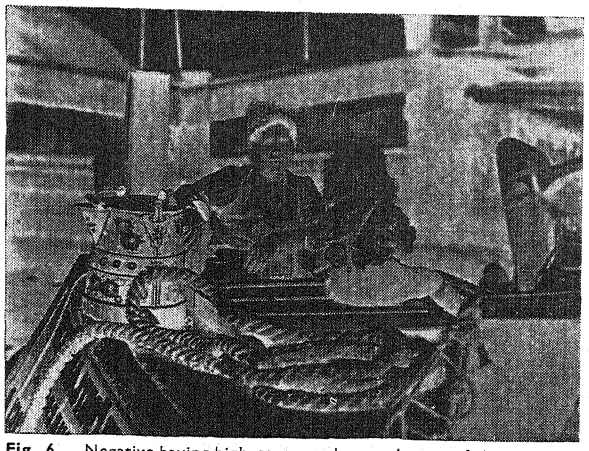


Fig. 6. Negative having high contrast due to absence of clear gelatine and extreme density brought about by prolonged development

in identical circumstances of subject and lighting, and have then been subjected to identical development.

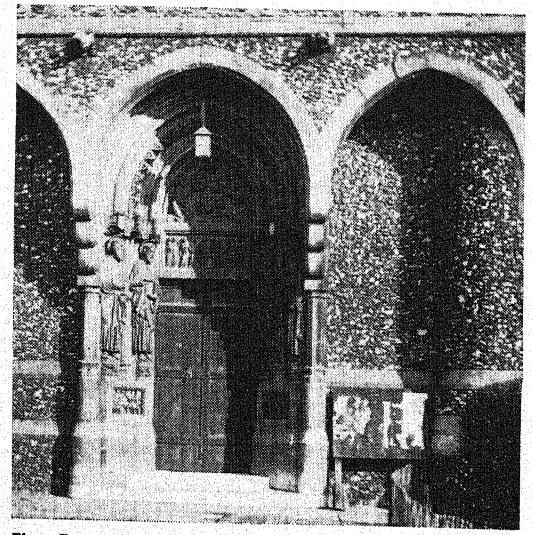
Figs. 7 and 8 are from prints made from the two halves of a stereoscopic negative. One lens was set at *f*6 and the other at *f*16, and the shutter was timed to give an exposure sufficient for the *f*16 image. This meant that one half the plate (at *f*6) received seven times the exposure of the other half (at *f*16). Development was carried out for a time calculated to give sufficient contrast for the less (but fully) exposed half of the plate, this naturally resulting in the other half acquiring extreme density. From this dense half it was, nevertheless, possible, by suitable exposure of the paper, to make a print having the same range of contrast as one made with a shorter exposure, and on the same grade of paper, from the less dense half.

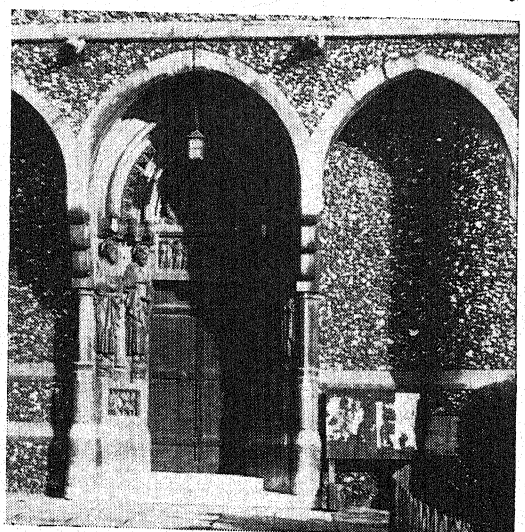
It is, in short, possible to get identical prints from negatives of different densities resulting from different exposures, but containing the same range of contrast through having been given identical development.

Instead of the density curve of a negative we may consider, as a rough illustration, a flight of stairs. This flight sweeps round in a curve at the bottom, then runs straight up for a considerable distance and ends with another curve round at the top. The surfaces of all the stairs in the straight part will be identical rectangles ; on the curved portions they will not be rectangular, nor will they be identical.

If we avoid the stairs on the bends and keep to those on the straight we can get various consecutive runs of identical surfaces. They might run from one to six, from two to seven, from three to eight, and so on. They would be identical sets of stairs, although some sets were higher up the flight than others.

Hurter and Driffield suggested that we should so adjust exposure and development that we get the required range of density





Figs. 7 and 8. How it is possible to obtain two prints with identical degrees of contrast from negatives of different densities is shown by these two pictures. They were made from the halves of a stereoscopic negative taken with one lens set at *f*6 and the other at *f*16. As a result, in development one half acquired extreme density, but by suitable exposure of the printing paper the same range of contrast was obtained in both prints

and contrast in the straight part of the flight, avoiding the curve at the bottom by avoiding under-exposure, and avoiding the curve at the top by avoiding over-development. It is good advice, endorsed by many other authorities, and should be followed whenever possible.

It is evident that, given appropriate sensitive material and approximately " correct " exposure, we can to a very great extent control the character of our negatives by development. We must pay regard to the characteristics of various developing agents, as explained elsewhere ; and having decided on the developer we must pay special attention to the time of development so as to secure the required degree of contrast.

With a little practice and experience it does not matter much what means we adopt as a guide to this time. We may choose the factorial system, time and temperature pure and simple, or judgement by inspection ; but we must know, first of all, the type of negative we require for our purpose before we can employ the best and surest means of securing that result.

As is explained under the appropriate headings, there are certain remedies, within limits, for correcting errors in development. If we have under-developed a negative we may improve it by intensification ; if it is over-developed, a suitable form of reduction may take it back to the condition it would have shown with shorter development. But there is nothing so satisfactory as being able to get the exact kind of negative required by development only.

Mass Development. It will be as well to consider briefly some of the pros and cons of what may be called mass development of negatives. It is a common practice for several plates or a whole spool of film to be developed at once in a tank or otherwise. Some of the advantages are obvious : saving of time and trouble ; minimizing damage through handling, and the risk of light-fog ; the possibility of doing some or all of the work without a dark-room ; avoidance of being misled by rate of development or visual appearance of the negative ; and so forth.

Are there any disadvantages in mass development? Some photographers find more or less pleasure in actually observing the process of development ; but this is a psychological rather than a practical point, and may be dearly paid for. But there is certainly one rather serious difficulty—that of giving differential treatment to one or more of the negatives in the batch. As far as development is concerned they all receive identical treatment, and this perhaps may not always be desirable.

If we examine, say, a tank-developed spool of film containing a number of negatives which may run to as many as 36, the chances are that there will be considerable differences of density and contrast. Clearly these differences cannot be caused by development. They are the result of differences in the character of the subjects and in the exposures given.

Subjects themselves differ enormously in contrasts of light and shade, and these contrasts, whether great or small, will be reflected in the negatives whatever the development may be. Differences of density in the negatives are most likely to be caused by considerable differences in exposure, as was exemplified in the case of the stereoscopic negative previously mentioned.

The One Drawback. The disadvantage of mass development is most serious when we wish to modify the contrast in the negative of a subject. If this subject was rather flat, and we wished to brighten it up a bit, we could do so by increasing contrast by giving additional development time. On the other hand, if the subject possessed extreme contrast which we desired to restrain somewhat in the negative, one way of doing so would be to give a full exposure (for the benefit of the shadows) and curtailed development (for the benefit of the high-lights). We might even wish to resort in such a case to what is known as the water-bath method.

None of these special modifications can be made with mass development, and this is almost the only drawback to the method. Naturally the trouble does not necessarily arise with any particular batch—but it may.

Water-Bath Control. The water-bath "dodge" deserves a word or two. It is valuable in the case of a negative which, owing to extreme contrasts of light and shade in the subject, may be unsatisfactory if developed in the ordinary way. The shadow details may be too scanty and weak, while the high-lights are too dense and " blocked

up." After a short time in the developer the negative is transferred to a dish of water and left there for a time without rocking. It is then returned to the developer for a further brief period, and again transferred ; and so on till development is complete.

This is the rationale of the method. A given quantity of developer can do only a limited amount of work in the reduction of silver. Its action slows down, and at last ceases. The gelatine has absorbed a certain amount of developer while in the solution, and this continues working in the plain water. In the high-lights, where there is much silver to be reduced, the developer soon ceases to act, but it continues to work on the shadow detail for a further time. A further absorption of developer leads to the process being repeated. The net result is that there has been more continuous developing action in the shadows than in the high-lights, and contrasts are more or less reduced.

The facts just mentioned explain the necessity for occasional movement of the solution during the progress of development. Otherwise the action is uneven, as the developer becomes unevenly exhausted in different parts of the emulsion. It is this irregular exhaustion which gives rise to " mottling," which is apparent in areas which should be more or less even in tone.

The " Perfect " Negative. The expression " the perfect negative " is sometimes used. This does not mean that there is such a thing as one absolute ideal to which the perfect negative must conform. The only meaning of the term is that a perfect negative is one which exactly suits the purpose or purposes for which it is intended ; and, as has been already pointed out, development is a most important factor in the production of such a negative.

But no possible development procedure can produce a perfect negative (in this sense) if unsuitable sensitive material has been selected for the exposure. There are some plates which will only yield a maximum density far below that of other plates. No type of developer, and no possible time of development, will produce on a plate designed for delicate portraiture, or on a super-sensitive plate designed for high-speed work, the same contrast that can be obtained readily on a slow " process " plate.

Assuming the correct choice of sensitive material for the purpose required, consideration must be given to the type of developer. One developing agent will bring out all detail quickly, but add density slowly ; this would be the kind to use to produce negatives of the soft, low-contrast character, with full detail everywhere, suitable for high-key work. Another developer is slow in bringing out detail in the shadows, but piles up density rapidly in the high-lights ; this would be suitable for contrasty subjects, such as a copy of a black-and-white drawing. A combination of the two types of developer might be the most appropriate solution, as calculated to give the required detail and contrast in a subject with a long and full scale of tones.

A familiar example of the three types is metol alone, hydroquinone alone, and a metol-hydroquinone combination.

It is not an uncommon thing for photographers to conclude that there is something wrong with their general development procedure when the trouble is wrong choice of sensitive material or developing solution.

Paper Development. So far we have considered only the development of negatives, and we may now mention a few of the salient points in other forms of development.

In the case of gaslight printing, development is a rapid process—much more so than in the making of negatives. Exposure of the paper must be so calculated that the image, of the full strength required, is obtained within a certain time limit, and further action must then be checked at once.

Gaslight Paper. In negative development the process is sufficiently slow to permit of adequate rinsing between development and fixing ; but with gaslight paper the continuing action is so rapid that the rinsing has to be perfunctory, and stains are the usual result. The best and safest course is to check development instantly at the right stage by transferring the print direct into a stop bath, which may be a weak solution of acetic acid or of potassium metabisulphite.

Fortunately, gaslight paper is so slow that it is safe to use a bright yellow light to watch development, and so to judge the exact moment at which to stop it. At the same time the exposure must not be so full

that development has to be unduly curtailed, and the instructions with any given gaslight paper generally specify a normal time of development which should be adhered to within narrow limits. This involves not only a reasonably correct exposure but the use of a developing solution that has not been at all overworked.

Bromide Paper. With ordinary bromide paper, development is a very different matter. We have here one of the very few cases in which development can be standardized and made merely mechanical, the process being governed entirely by exposure. It is certainly possible, as with gaslight paper, to stop development at any stage short of finality, but the finest results by this process are obtained by " complete " development.

That is to say, the exposure is adjusted to make it possible to develop the image as far as it will go ; and to make sure that this is the case the paper is left in the developer for a short time after the picture has apparently gained full strength. It must be impossible to over-develop.

When a print so treated has been thoroughly fixed and rinsed, it is examined in a good light ; if it is too weak another print should be made with a sufficient increase of exposure ; if it is too dark the next exposure should be reduced. It is a common practice to find the correct exposure by exposing a strip of the paper in sections with graduated exposure times, develop this to finality and examine the results (*see p.* 197).

This " finality " development is particularly advisable in the case of prints that are to be subsequently toned, especially by the sulphide process. Colour and quality are far superior to those resulting from toning a print that has been only partially developed. An exception is the case of bromide prints intended for bromoil treatment, when development is generally stopped before full blacks are obtained.

Further difference of procedure arises in the case of chloro-bromide paper. With this medium, development will produce a variety of colours—black, warm blacks, cool sepias, warm browns. The differences are the result of varying both the exposure and the composition and strength of the developer, while the time of development is judged by observation.

The method which is calculated to give the best results is as follows. When development of the exposed paper is commenced the time of the first appearance of the image is generally very much longer than in the case of bromide paper. Once the image appears, however, it steadily gains strength, and development should be continued till the lightest tones are visible.

If it is seen that the print is flat and lacking in contrast, the exposure has been too long ; if the shadows are heavy and blocked up, it has been too short. An exposure must be found so that on development till the lightest tones appear a print is obtained with good tone values in both high-lights and shadows. This exposure is, of course, correct only for the particular type of negative and the developer as constituted. Should the developer be further diluted and restrained to give a warmer colour, exposures will be longer, but the correct time must be found as before to get a print with satisfactory tones when development has been carried to the stage of the appearance of high-light detail.

Lantern Slides. The development of lantern slides—a rather complicated business —may be considered briefly. Some lantern plates are made to give black tones, others will give not only as wide a range of colours as chloro-bromide paper, but several others, by development only. With black tone slides it is possible to calculate the exposure so that development can be carried to finality as with bromide paper ; with warm-tone slides there is a close resemblance to the procedure with chloro-bromide.

There is a special method of development with warm-tone slides which deserves to be more widely known than it is, especially as it practically eliminates " wasters." The warmest tones are obtained in slides by increasing exposure and using a diluted and restrained developer, and this can be done in varying degrees. It is on this fact that the special method is based.

It is briefly as follows : Three solutions are made up, for cool, medium and warm tones respectively. Development of the exposed plate is commenced with the warm-tone solution. If after a time development has proceeded till the high-lights are slightly but distinctly veiled over, the slide will

probably be satisfactory. But if this stage is not reached in a reasonable time the exposure has been too short for the developer. The slide is rinsed and transferred to the medium-tone solution, in which it may develop up properly. Failing this, it is again rinsed and treated with the cool-tone solution.

This method clearly gives great latitude in exposure; so much so that two solutions instead of three are generally sufficient. The colours of the slides will vary according to the solutions used, but this is usually an advantage rather than otherwise.

DIAPHRAGM. The name given to a partition placed in front of or behind a single lens, or between the components of a multiple lens, and pierced with an aperture which regulates the amount of light passing through the lens. *See* Stop.

DIAZO-DYE PRINTING PRINCIPLES & APPLICATIONS

For certain types of photographic reproduction the diazo-dye system of printing offers some advantages. Mr. J. F. Stirling, M.Sc., A.I.C., here describes the process, the materials used, and explains how they are employed for copying and other purposes

There exist a number of photographic printing processes, several of which have reached the commercial stage, which are based upon the light-sensitivity of certain complex organic substances known to chemists as the *diazo* or *diazonium* compounds. These compounds are formed by acting with nitrous acid upon certain aniline derivatives and they have the property of combining or "coupling" with other organic substances in the presence of alkali to form still more complex compounds, many of which are highly coloured.

Many of the diazo compounds are highly explosive in the dry state. They all decompose when heated, giving off nitrogen, thereby losing their power of "coupling" with other compounds. This same power may be lost when the diazo compounds are exposed, and it is upon this fact that the various diazo-dye printing methods are based.

If paper is coated with a diazo compound, exposed under a positive and then immersed in an alkaline solution of the "coupling" agent, the diazo compound which has been least affected by light will combine with the coupling agent, forming a brightly coloured image; whilst the diazo compound which has received most light influence will have been more or less completely destroyed, and will, therefore, not undergo this characteristic coupling reaction. Thus a positive image will be developed upon the paper, while if the paper has been exposed under a negative, a negative image will result.

The highly coloured image which is developed on the paper is actually a dye of the "diazo" class. Hence, to all reasonable influences it is quite permanent.

The earliest dye-printing process based upon the diazo reaction is the Primuline process, which is founded upon the light-sensitivity of the diazo compound of Primuline, a yellow dyestuff.

Present-day commercial diazo papers, however—as, for instance, the well-known Ozalid dry-development papers—apply the diazo reaction to better advantage. They are employed almost exclusively for the reproduction of drawings and other black-and-white subjects, replacing, in this respect, the older ferro-prussiate blue-print papers. There is little reason, however, why such dry development diazo papers should not in time be utilized for the printing of ordinary photographs, since they can be processed with great ease.

The present-day commercial diazo printing papers may be divided into two general types, *viz.* those which are dry-developed by exposure to the fumes of ammonia and those whose development is conducted by sponging with a solution of the diazo coupling agent.

The former variety of diazo papers are prepared by coating their surfaces with a mixture of diazo compound and coupling compound, these being prevented from combining together by the presence of a trace of acid. After exposure through a positive (as, for instance, a semi-transparent sheet of paper upon which the drawing to be reproduced has been made) the diazo paper is subjected to the action of ammonia fumes for a period of between five and twenty minutes, during which time the ammonia neutralizes the acid and allows the diazo compound on the paper surface which has not been destroyed by light-action to combine

with the coupling agent, thus producing a highly coloured image.

In the second class of diazo papers the paper surface is coated with the light-sensitive diazo compound together with a certain proportion of gelatine and a trace of acid, which, it is found, increases the light sensitivity of the diazo compound. Development of these papers is effected by dissolving " developing powders " (consisting of the diazo coupling agent and a little alkali) in water and by sponging the resultant solution over the exposed paper. Alternatively, the paper may be passed between felt-wrapped rollers impregnated with an alkaline solution of the coupling agent.

By the use of diazo papers it is possible to copy a drawing or a document without the aid of a camera. The document is laid upon the glass of a printing frame and the paper is placed over it, sensitive side, of course, downwards. The printing-frame is closed and then exposed to light, after which the diazo paper is withdrawn and developed.

Cellophane has been impregnated with diazo compounds and used for printing purposes, and by coating paper with special types of diazo compounds which can act as their own coupling agents it has been possible to produce diazo papers which give a positive print from a negative image.

Diazo papers, as a whole, must be very accurately exposed. Under-exposure gives dirty high-lights in the prints, whilst over-exposure, owing to the almost complete destruction by light-action of the diazo compound in the paper, gives images which are faint and, indeed, often non-existent.

DIN SYSTEM OF SPEED RATING

Continental film manufacturers have now universally adopted the DIN method of sensitivity grading. In the following article Leo A. Leigh, B.Sc., A.R.P.S., describes the actual method of determination of the system of speed rating

The DIN system of determining sensitivity owes its name to the " Deutsche Industrie Norm " and was adopted in 1934.

Whereas the older Scheiner system relied on the measurement of the threshold value of an emulsion, the DIN system measures the least printable density, which is defined as a density of 0.1 above the level of general fog.

In order to standardize the conditions of the actual test, the German Specifications rigidly specify the type of apparatus, light source and developer to be used in the measurement of sensitivity by the DIN method.

The sensitive material is placed in an exposure apparatus, where it is exposed for exactly 1/20 sec. behind a special step wedge. The source of light is specially filtered so that it approximates as much as possible in spectroscopic composition to noon sunlight.

After exposure the test strip is developed to finality in a specified metol-hydroquinone developer. The resulting sensitometric strip is placed in a photometer which measures the step with a density of 0.1 above fog level.

The density of the wedge step under which this density of 0.1 is found on the strip gives the DIN speed of the emulsion.

In order to avoid confusion with other systems of speed markings, a special notation has been adopted for the DIN system whereby the densities are expressed in the form of a fraction. Thus, if the density of the particular step is found to be 1.3, then the corresponding DIN sensitivity is written 13°/10.

A difference of 3°/10 DIN corresponds to a difference of 100 per cent. in the speed of the emulsion, so that a film rated at 17°/10 DIN is twice as fast as one rated at 14°/10 DIN.

An exact conversion of DIN speeds into H. & D. or Scheiner speeds is not possible, owing to the fact that the three systems are based on fundamentally different methods of determination.

With emulsions of similar characteristics comparison is easier and, as a rough guide, DIN speeds may be converted to Scheiner speeds by disregarding the denominator of the fraction and adding 10 to the numerator. Thus 13°/10 DIN equals 23° Sch.

The table below may be used for comparing H. & D. and DIN values, but, as already stated, it is only approximate.

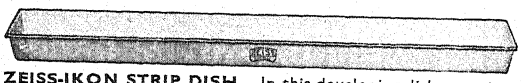
H. & D.	DIN	H. & D.	DIN
200	8°/10	1,600	17°/10
400	11°/10	2,000	18°/10
800	14°/10	2,500	19°/10
1,000	15°/10	3,200	20°/10

The above table has been worked out by the Weston Electrical Instrument Corp.

LEO A. LEIGH, B.Sc., A.R.P.S.

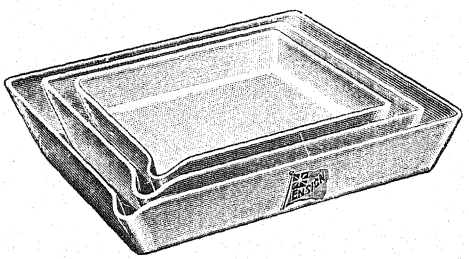
DISHES. For photographic use dishes are usually rectangular in shape, of various sizes and depths, and can be obtained in porcelain, glass, bakelite, xylonite, papier mâché, celluloid, enamelled and stainless steel.

Dishes should be of good size and depth. It is a mistake, unless using half-plate or larger material, to buy dishes of the same size as the plates.



ZEISS-IKON STRIP DISH. In this developing dish an entire length of film, vest-pocket size, can be treated at one time. At each end of the dish is a clamp to hold the film firmly in place

Porcelain dishes are probably the best in the long run. Any deposit is instantly seen and can be easily removed from the glazed surface. Bakelite and similar moulded materials have the advantage of lightness and are almost unbreakable, but enamelled dishes are sometimes unsatisfactory as the enamel is liable to crack. Stainless steel dishes are expensive, but are robust, non-chipping and non-rustable.



ENSIGN DEVELOPING DISHES. This set of three dishes is made of finest quality Staffordshire porcelain with a hard glaze finish to resist chemical action. Sizes are made from 3½ × 2½ in. to 18 × 14 in., either deep or semi-deep

Some dishes are made with ribbed bottoms, which facilitates the handling of plates when in a solution. Others, for film development, have a revolving circular bar across the top of the dish which ensures that the film, when developed by the "see-saw" method, is kept under the surface of the solution.

Another form of dish, such as the Zeiss-Ikon Strip Dish, is long enough to take a whole length of vest-pocket size film, and has a clamp at each end to hold the film.

Dishes of moulded materials such as bakelite and xylonite are usually made in two colours, red and black. This is useful, since, if one colour is kept always for developers and the other for fixing solutions, there is no risk of mixing them up, or of pouring developer into a dish impregnated with hypo.

Occasionally, when making extra size enlargements, it may be found that there are no dishes large enough to take the bromide paper. If work of this kind is not carried out often enough to justify buying extra dishes, quite serviceable ones can be made of wood—wooden strips for the sides and a sheet of three-ply for the bottom. When assembled the dishes should be coated with cellulose and after they have dried a further coat of cellulose should be applied, followed by a double coating of white, acid-proof enamel.

One drawback to many of the xylonite dishes on the market is that they are rather thin, and as they bend easily it is difficult to lift them up, when full of liquid, without spilling some of the contents. A rectangle of plywood, fitted under the rim of the dish and fixed to it by screws, will overcome this.

Notes on the Composition of 'PALS'



Subject and treatment could hardly be simpler and more straightforward than in this print. The subject is one that appeals at once to all animal lovers—practically everyone who is really worth appealing to; the treatment is all that was needed in the circumstances—a realistic rendering of the two pals. Unlike some human sitters they are just their natural selves, and therefore lovable.

In the sketch two circles have been struck with centres at the intersection of lines dividing the picture into thirds horizontally and vertically. It will thus be seen that the two heads are placed around two strong points diagonally positioned in the picture space. Further, it cannot be said that either head is definitely stronger than the other; they have a practically even pull.

The result is, in a sense, a division of interest; but in this case it does no harm. As we look at one head we are vaguely conscious of the other awaiting its turn, and we can transfer our attention from one to the other again and again with pleasure and not discomfort.

Tone values are good and well balanced. The lower dog gives a strong dark mass with sound foundational value; the other is a combination of light and dark tones, giving variety; the background is an almost even tint about midway between the darks and lights of the dogs. It is a simple but admirable treatment.—*W. L. F. W.*



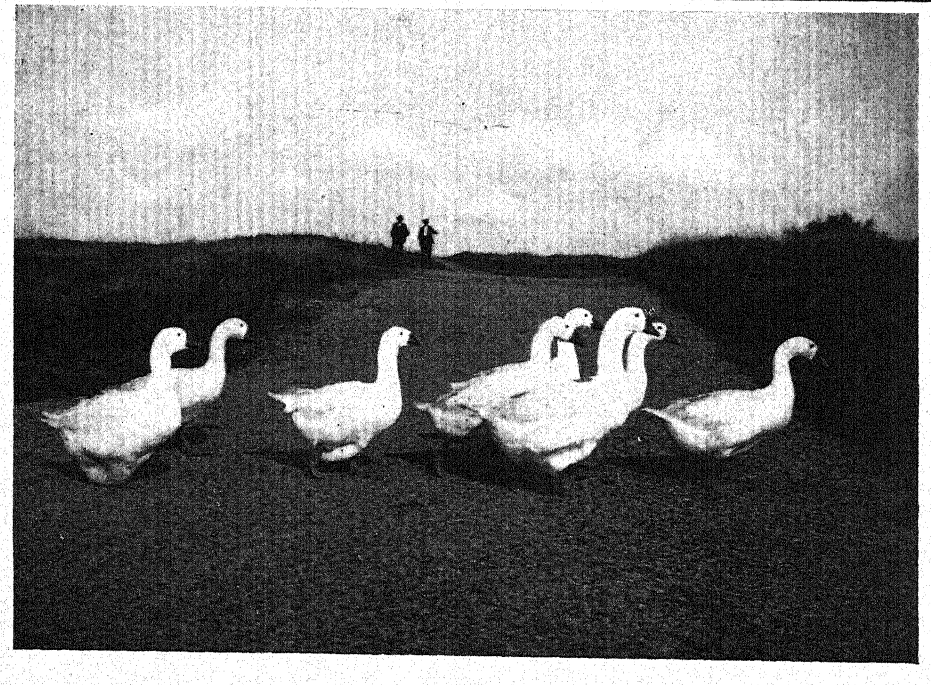
PALS Jack Barsby

Exhibited at the London Salon of Photography, 1935



'THAW'

John T. Knight, 2 p.m. in March; Zeiss Ikonta camera; Agfa I.S.S. film; 1/50 sec. at *f*11; K2 filter



Prizewinning photographs in "Modern Encyclopedia of Photography" Competition

'AND SO TO BED'

C. Ilott, Anglesey. September, approximately 5 p.m.; Verichrome 120 film; 1/25 sec. at *f*8



'I WAS THERE' — Albert Towers

Prizewinning photograph in "Modern Encyclopedia of Photography" Competition: taken in Trafalgar Square, September, at 11.30 a.m. Selochrome Film Pack; 1/10 sec. at f11

dark-room the number of frames occupied by the fade, or, if the camera has a re-wind, use this until the requisite number of frames have been wound back, with the lens cap on. Now expose the second shot on this length of film, fading in on the same number of frames as have been faded out.

DISTANCES : JUDGING. One great drawback to the use of a hand camera not provided with a range-finder is the inability of many people to estimate distances correctly when setting the focussing scale.

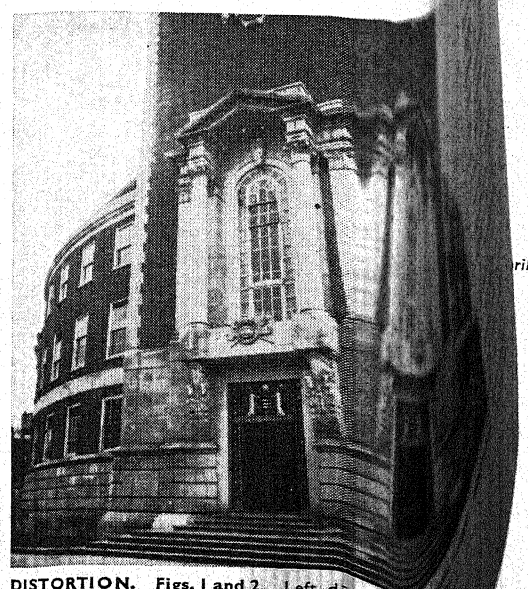
A useful method of estimating distances is to view a person of average height in the finder of the camera and measure out how far away he has to stand in order to fill the entire height of the finder. The person should then walk back until his figure appears three-quarters, half and quarter size. These distances should then be measured and memorized. *See* Range-Finder.

DISTORTION: CAUSES & PREVENTION

A common fault in beginners' photographs is incorrect perspective. In the following article (illustrated by the author) the matter is fully discussed by Mr. Bernard Alfieri, Jr., who explains how to avoid perspective faults. For distortion deliberately employed see Caricature.

Distortion, or exaggerated perspective, is present in any image formed by a wide-angle lens where a three dimensional object is too near to the camera. While badly distorted photographs may be lamented, the same trouble can be sometimes turned to advantage if deliberate use is made of the phenomenon.

The normal focal length of a lens has been determined for various sizes of negatives to give the best general



DISTORTION. Figs. 1 and 2. Left, di... uprights simply...



Leo A. Leigh, A.R.P.S.

rilliant moonlight on the water

DISK OF CONFUSION. If a theoretically perfect lens is focussed on a given plane, it will produce perfect definition of objects situated in that plane only. If we imagine a series of points of light in various planes, and if we focus the lens on one of these, the image of the focussed light will register as a point, while the definition of the points of light in front and behind it will fall off, so that instead of registering as points they will appear as small circles.

Provided these circles are sufficiently small, the eye will fail to distinguish them from a point, and this maximum permissible amount of " unsharpness " is called the disk or circle of confusion.

In practice a circle of 1/100 in. diameter, viewed at a distance of 10 in., will appear to the eye as a dot, and 1/100 in. can be therefore taken as the largest permissible disk of confusion for contact prints.

If the negative is enlarged, the disk of confusion will be enlarged also, so that for negatives requiring enlargement, 1/100 in. will not be sufficiently small to start with.

Strictly speaking, in order to preserve in the enlargement the same degree of sharpness as in the contact print, the disk of confusion of the negative should vary inversely with the degree of enlargement. Thus, if we wish a 10-diameter enlargement to show the same degree of sharpness as a contact print, when viewed from the same distance, the negative should have a disk of confusion of 1/1000 in., which would correspond to 1/100 in. in the enlargement, *i.e.* the same as the maximum permissible disk of confusion for contact prints. Such close limits are seldom necessary, since big enlargements are usually viewed at a distance greater than 10 in.

In practice, for general work and medium-sized enlargements, it is usual to choose a disk of confusion of 1/200 in.–1/250 in., while for miniature negatives a smaller value is generally taken, *viz.* 1/500 in.–1/750 in.

DISPERSION. An optical term signifying the breaking up of a beam of light into its component rays, as, for instance, when a ray of light passes through a prism and is separated into its component spectral colours. Dispersion must be distinguished carefully from refraction (*q.v.*), which denotes merely the bending of light rays. A good lens will bend or refract light rays without actually dispersing them. If, however, the lens has not been properly corrected for chromatic aberration (*see* Lens), it will tend partly to disperse the light rays which pass through.

By constructing a lens of different kinds of glass possessing different dispersive powers, the dispersion of the lens as a whole can be neutralized, and such lenses are termed achromatic.

In pictorial photography and particularly in portraiture, the controlled dispersion of light may become a very valuable asset to the photographer by enabling him to produce photographs in which the definition is pleasantly softened, without actually flattening the appearance of the image as a whole. Such " soft focus " effects are most conveniently produced by using a large-aperture lens which has been more or less uncorrected for chromatic aberration, or, alternatively, by employing a portrait lens in which, by the rotation of a small knob or ring, a definite amount of aberration may be introduced into the lens system.—*J. F. STIRLING.*

DISSOLVE. A term used in cinematography (*q.v.*) One scene appears to overlap another, the first dissolving into the second, but without any loss of screen brightness, the end of the first shot being faded out and the beginning of the second faded in.

The cinema dissolve is used to telescope time, *e.g.* shots of the various stages in the manufacture of an article are dissolved into each other since it would be impracticable to show the complete process in detail. It should be used when the relationship of two shots, either by resemblance or contrast, needs to be brought out or to indicate time lapse, *e.g.* a full plate dissolving to an empty plate. It may also be used in the middle of a tracking shot to prevent the movement from becoming monotonously long, but like other " mechanical " devices, discretion must dictate its employment. It should not be put in merely because it makes a change from the simple cut, but because the nature of the shots or the idea it is intended to convey call for it.

To dissolve on negative-positive stock, simply fade out the end of one shot and fade in the beginning of the second, and print with the ends overlapping. For reversal film, fade out the first shot, keeping a careful note of the number of frames us[ed] for the fade. Wind back the film in

dark-room the number of frames occupied by the fade, or, if the camera has a re-wind, use this until the requisite number of frames have been wound back, with the lens cap on. Now expose the second shot on this length of film, fading in on the same number of frames as have been faded out.

DISTANCES : JUDGING. One great drawback to the use of a hand camera not provided with a range-finder is the inability of many people to estimate distances correctly when setting the focussing scale.

A useful method of estimating distances is to view a person of average height in the finder of the camera and measure out how far away he has to stand in order to fill the entire height of the finder. The person should then walk back until his figure appears three-quarters, half and quarter size. These distances should then be measured and memorized. *See* Range-Finder.

DISTORTION: CAUSES & PREVENTION

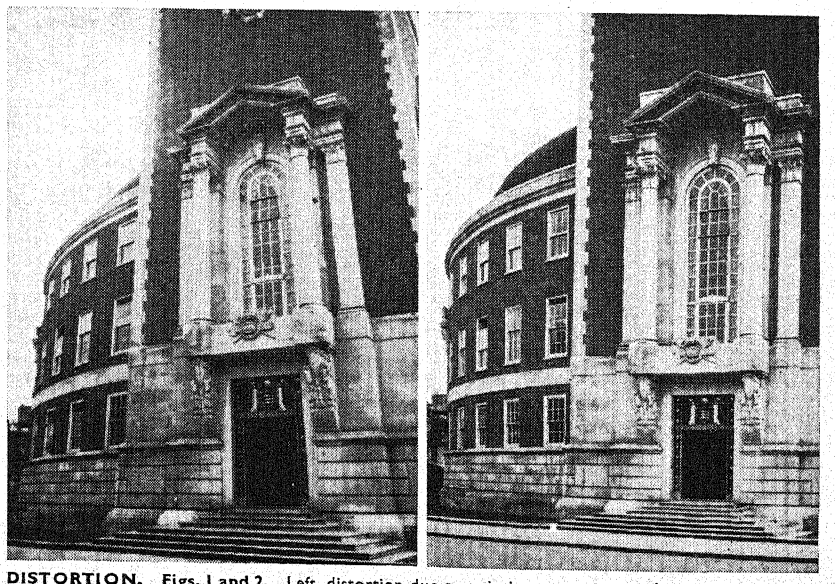
A common fault in beginners' photographs is incorrect perspective. In the following article (illustrated by the author) the matter is fully discussed by Mr. Bernard Alfieri, Jr., who explains how to avoid perspective faults. For distortion deliberately employed see Caricature.

Distortion, or exaggerated perspective, is present in any image formed by a wide-angle lens where a three dimensional object is too near to the camera. While badly distorted photographs may be lamented, the same trouble can be sometimes turned to advantage if deliberate use is made of the phenomenon.

The normal focal length of a lens has been determined for various sizes of negatives to give the best general perspective and convenient angle of view; thus an objective with a focal length of about 6 inches would be normal for a quarter-plate, or one of 2 inches would give approximately the same angle of view in a miniature camera with a negative frame 36 × 24 mm. The latter is an angle of 47 deg., and provided the camera is not used too close to the subject, familiar perspective will be obtained.

When a wide-angle lens is employed, that is, a lens with a much shorter focal length than normal, or alternatively a portrait attachment, or other optical means of allowing the camera to approach very close to the subject, the angle of view is increased until all perspective is greatly exaggerated. If the subject being photographed is a flat surface and the camera is level—that is, the axis of the lens is central and at right angles to the subject—no distortion will be shown, but if the camera is pointed upwards, or downwards, all vertical lines will show exaggerated perspective and present the familiar appearance of converging uprights. Distortion due to pointing the camera upwards is shown in Fig. 1, while for Fig. 2 the camera was level.

A similar camera movement at an angle sideways will produce the same effect to horizontal lines. Where the subject is three-dimensional, the exaggeration of perspective will increase as the camera is moved closer to the subject, until with a very wide-angle



DISTORTION. **Figs. 1 and 2.** Left, distortion due to pointing camera upwards, and, right, correct uprights simply obtained by holding camera level

lens employed extremely close to the subject there is such distortion that the picture would be practically valueless. Conversely, if a lens of much longer than normal focal length were used a great distance from the subject, there would be a flattening of perspective and the distance between objects one behind the other would not be apparent.



Figs. 3 and 4. Left, photograph of a building taken with a camera with a wide-angle lens. Note how the length of the receding lines is exaggerated, due to too near a viewpoint. Right, the same subject with correct perspective obtained by use of a longer focus lens and more distant viewpoint

Exaggerated perspective can often be turned to advantage to convey size. For instance, a picture of a large railway engine taken from a low forward standpoint on a normal focus lens will present a reasonable record of the subject, but if a slightly shorter focus lens is employed on the same camera, the front of the locomotive will appear larger in proportion to the back and give an impression of greater size and strength. If an exceptionally short focus lens is used from a still closer viewpoint, such great distortion will be shown that the picture is valueless.

In architectural work, photographing interiors with a very wide-angle lens not only makes it possible to include more subject matter than would otherwise be possible, but it offers a greater feeling of depth and makes a room appear larger than it really is, often giving great satisfaction to the owner. Correct perspective must be watched when photographing receding lines or corner buildings. Particularly when a wide-angle lens is employed the perspective will be exaggerated if a near viewpoint is selected. An example of this is shown in Fig. 3, and the same subject is shown photographed with a longer focus lens from a more distant viewpoint (Fig. 4).

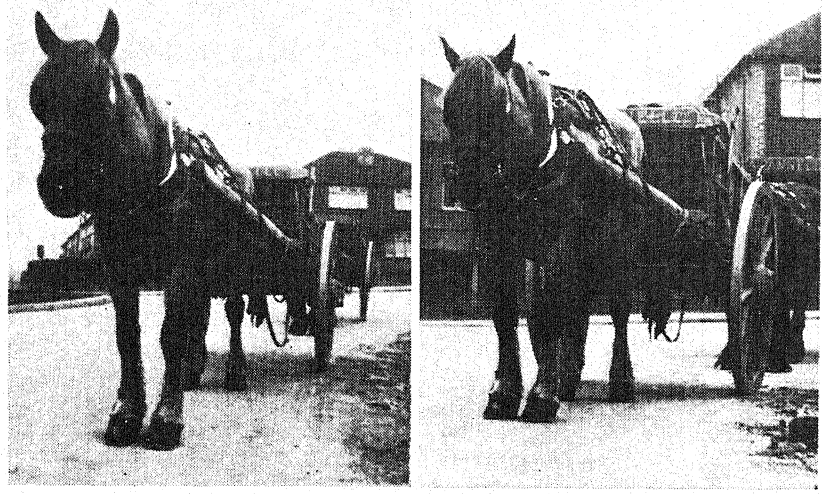
In portraiture, or the photography of groups, distortion is much more disturbing. Most beginners with a small camera, and probably a portrait attachment, try to fill the frame and approach the subject too closely when the camera is used for the first time. If under these conditions, even with a normal focus lens, arms or legs are well forward of the body, they will be shown in the photograph so greatly enlarged that they are out of all proportion.

For similar reasons if a low viewpoint is chosen, there may be a big chest with a small head, or a row of enormous legs in front of a series of small bodies.

In conventional portraiture many professionals use the camera at about eye level for head and shoulders, and employ a lens of considerably longer focal length than normal, obtaining an image full size on the negative. If an image of the same size were attempted with a wide-angle lens from a much closer viewpoint, the nose or other prominent portions of the face would be shown in exaggerated perspective, and the near portions would be enlarged out of proportion to the rest of the subject.



Figs. 5 and 6. Left, portrait with figure in correct proportion, due to subject being seated and camera being at eye level. Right, result of holding camera too low and pointed upward, with subject standing. Head is distorted in relation to body



WIDE-ANGLE DISTORTION. Figs. 7 and 8. Left, how a wide-angle lens gives an apparently unnatural perspective. Viewed at very close quarters the photograph looks more nearly correct. Right, the same subject taken at a greater distance with a long focus lens. At normal viewing this looks correct, but at very close quarters the head appears too small

The photograph of the horse and cart in Fig. 7 was taken with a short focus lens, and the camera was used near to the subject. Fig. 8 shows the same horse photographed from a more distant standpoint with a fairly long focus lens, and in each case the animal occupies about the same picture area on the negative. If the camera had been maintained at the more distant viewpoint for both exposures, the perspective would, of course, have been identical.

When photographing subjects such as a car, the camera should not be held too near or distortion will occur (Fig. 9). If only one lens is available it is far better to take the subject much smaller and rely on enlarging.

The ideal miniature negative under these conditions would be obtained by using a long focus lens, the subject filling the negative area, whilst the camera is used reasonably far away.

This does not mean that a really long focus lens or telephoto lens isrequired, the usual 5-cm. focus lens on 35-mm. film is quite suitable for a subject such as a car, if it about fills the negative, whereas a lens of about 7 cm. would be ideal for the same subject, if it is to fill the entire negative and produce a result as shown in Fig. 10.—*Bernard Alfieri, Jr.*

DITMAR CINE CAMERA. Made by R. Ditmar, of Vienna, and marketed in England by Actina, Ltd., this cine camera is made in two forms, for 16-mm. and 9.5-mm. film. It is a high-precision instrument finished in black and chrome, or tortoiseshell, and has many features that set it high among sub-standard cine cameras, and which are found to make filming easier and more certain for the beginner. Single pictures can be taken by a hand crank, and continuous running is made possible.

Among these features are an adjustable peep-hole to the spy-glass view-finder, a continually visible and adjustable iris scale, and a change-of-speed device which can be brought into play without interruption of shooting. The adjustable peep-hole has a sliding eye-piece which, when it is slid to the right as far as possible, automatically corrects the finder for close-ups; in this position a blue-tinted screen covers half of the peep-hole, acting as a reminder that the camera is set for close-ups, and in addition a red dot

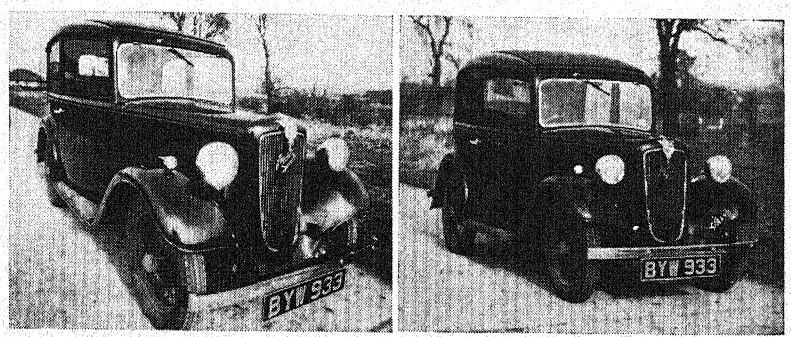
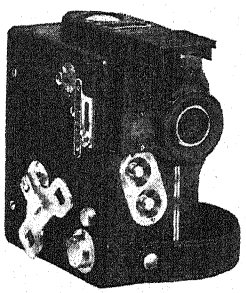


Fig. 9. Examples showing how too close a range produces severe distortion (left), and how better results are obtained by a more distant viewpoint (right Fig. 10). The subject is afterwards enlarged

appears on the eye-piece plate and shows at once how the finder is set.

The second feature is that it is possible to see, above the view-finder, scales which show which lens aperture is being used and also the amount of exposed film. Thus one does not have to remove one's eye from the finder or stop filming for a second to learn these two important facts. There are also external indicators for lens aperture and amount of film exposed.

The change-of-speed device is worked by push-buttons, one for each speed—16 and 32 frames per second. A further improvement, not mentioned above, is the single-picture device operated by a separate hand crank; the shutter, when this is in use, remains open while the crank is at the top of its cycle, so that time exposures are made possible by arresting the movement of the crank at that point.



Ditmar 9.5 mm. cine camera with built-in visually-coupled photo-electric cell

Telephoto, wide-angle, portrait and colour filter attachments are available, all fitted to the lens by universal screw thread. The lens in the fixed-focus model is a 20-mm. 2·9 Steinheil Cassar, and that of the focussing camera a 20-mm. 1·8 Berthiot Cinar.

The Ditmar Duo projector, by the same makers, takes two sizes of film, and the film can be changed, the makers claim, in ten seconds. There are 250- and 500-watt models, both with *f*1·6 lenses, interchangeable with longer or shorter focus lenses. Rewinding is done by motor. Controls, which are all on one panel, are provided for forward and reverse, "stills," etc.; and panels, or pilot-lights, illuminate the film loops and controls.

DOCUMENTARY FILM. A portrayal of reality, a reporting of events, the documentary film cannot be defined by subject matter because it is the method and not the matter that determines its function. The producer must, however, know his subject thoroughly. If his knowledge of it is superficial, then the resultant film is not a documentary; it is not, in fact, a documental record. Thus, Flaherty's "Man of Aran" cannot be so characterized. It romanticizes the subject and gives a false perspective.

The documentary analysis explains how and why; it can pose questions, but need not necessarily supply the answer, so long as the audience are given sufficient facts from which to work it out for themselves; *e.g.* in a film on housing conditions it is not incumbent on the producer to seek a solution to the problem he poses or to suggest remedies for the evils he exposes. If the film is sufficiently analytical it will speak for itself. But it is not enough to show shots of mean buildings and the like; these are only the outward signs. The producer must probe deeper, show what causes slums, how the people in them work and play, within what limits their lives are bounded, and so on. In the same way, if one is making a documentary film of, say, London, one must show much more than the important buildings, the parks and the attractions popularly described as "the sights." The flower-sellers round the base of the statue of Eros in Piccadilly, the street cleaners, the public-houses as well as the grand hotels, the milk bars, the urchins playing in the streets—these are as much expression of the real London as Trafalgar Square or St. Paul's Cathedral. A film of London must show the people of London; it must be a cross section of actuality, but note that it can rarely be successfully more than a cross section.

To attempt to show an all-embracing view in a short film of a subject such as a big city would entail abandoning the analytical approach. Better to concentrate on one aspect: London shown through the eyes of a city worker from his arrival at nine until his departure at six; the parks of London (and necessarily the people in them); the nurse-maids flirting with soldiers, riders in the row, small boys riding on soap-box carts, the down-and-outs, the park in early morning and the paper-strewn park in the evening.

To take another example: in a film intended to be a documentary of, say, an arterial road, it is not enough to show various views of it such as can be seen by any passer-by. The producer must first get to learn as much of his subject as he can. The audience will need to know the length of the road. How many accidents have there been

since it was opened? Were they due to culpable carelessness and excessive speed or bad lay-out. For instance, is there adequate lighting at the cross roads? Are the banks too steep? Are the traffic lanes used in a proper manner? If accidents have been few, is this due to good design? How many vehicles pass a given spot in a given time? Is the road safe for children? Is there any ribbon development? To what and to where is it a short cut? Has it relieved congestion elsewhere? Why, in short, was the road constructed?

The advantage of the documentary method is that it readily conforms to the amateur's requirements of a film that can adequately be produced with a limited footage and that does not pose too many problems of continuity. He is dealing with facts and not fancies, so is surer of his ground. But he must feel strongly about the subject he selects, and though he is dealing with actuality his approach must not be too objective. An English landscape painter goes to the scene and paints what he sees. The Chinese painter will also pay many visits to the scene, but he will not start to paint it until he returns home. He will have co-ordinated and analysed his impressions of and reactions to the landscape, so that while his picture will not be linearly accurate, it will be a vital expression of the scene as it appeared to him. That is the crux of documentary; the producer should not have great concern with how a thing appears to other people but how it affects him, and he must be at pains to marshal his facts so that what appears plain to him is equally obvious to his audience.

English documentary films are among the best in the world. Unfortunately their distribution is sadly limited, but they are frequently shown in news reel and repertory cinemas. They have a longer life than the average "feature" film, so that the list below of films which should be seen is not necessarily invalid because most of them were produced from 1929 onwards: "Granton Trawler" (directed by Edgar Anstey); "Drifters" (John Grierson); "B.B.C.—The Voice of Britain" (Stuart Legg); "Contact" (Paul Rotha); "Six-Thirty Collection" (R. A. Watt); "The Song of Ceylon" (Basil Wright); and "Night Mail" (G.P.O. Film Unit).—*GORDON S. MALTHOUSE.*

DOG PHOTOGRAPHY: A SPECIALIST'S METHODS

Thomas Fall

No domestic animal is more suited as a subject for camera portraiture than the dog, for his intelligence, lack of camera shyness and appealing ways help the photographer to obtain attractive and "to-the-life" studies without great difficulty. Here Mr. Fall, the well-known specialist in animal photography, explains the methods he adopts in photographing dogs

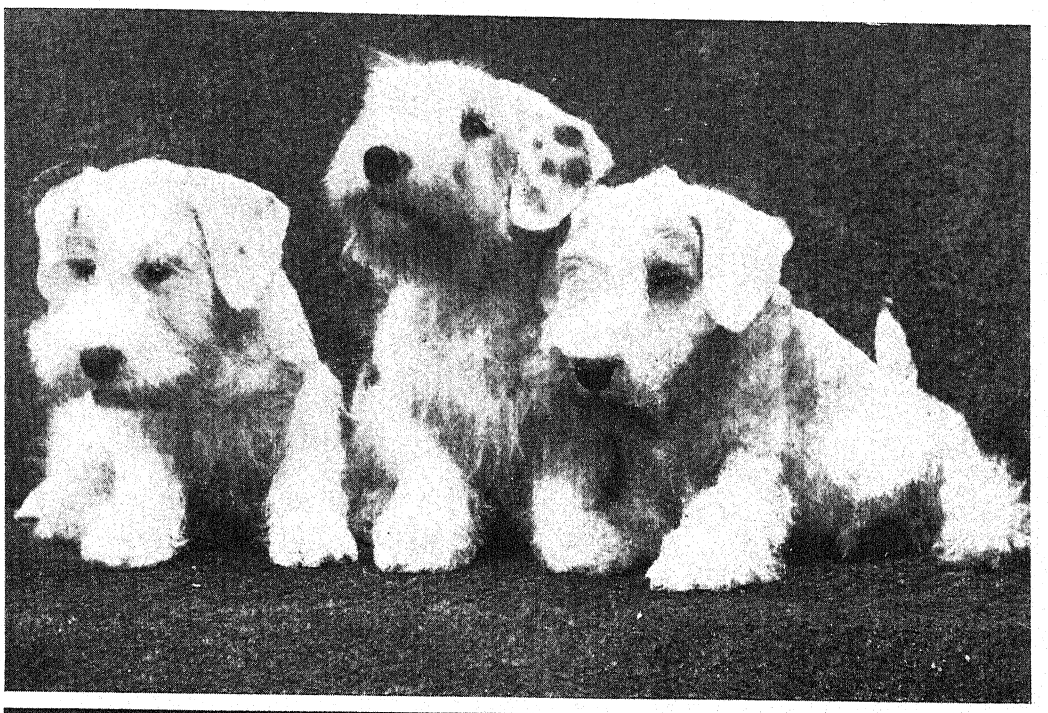
See also Cat; and Horse Photography

FOR so long a time has the dog been considered a friend and companion of man that he has lost that tendency to show camera shyness which exists with so many animals. He has almost developed a liking for being photographed, so the would-be dog photographer has a somewhat simple task when he sets out to make pictures of his favourite dog.

Almost any kind of hand camera can be used to get snapshots of dogs, but there are one or two types that are particularly suitable for taking more carefully conceived portraits. Most hand cameras are fitted with lenses that have rather a wide angle. These are quite good for taking general views, but when used at a reasonable distance away from the subject to be photographed, they show a very small picture on the film. To get a large picture, especially one of a very small dog, it is necessary to get very close up to the subject, and distortion often occurs.

The lens therefore plays a very important part in successful dog photography, whatever kind of camera is used, and it is just as well to discuss first of all the kind of lens that is most suitable. If one of a short focal length, or one with a very wide angle is used to photograph a dog in any position in which the head and front are nearer to the camera than the body and hind legs—*i.e.* if the dog is not exactly in profile to the camera, the result will be considerably out of proportion.

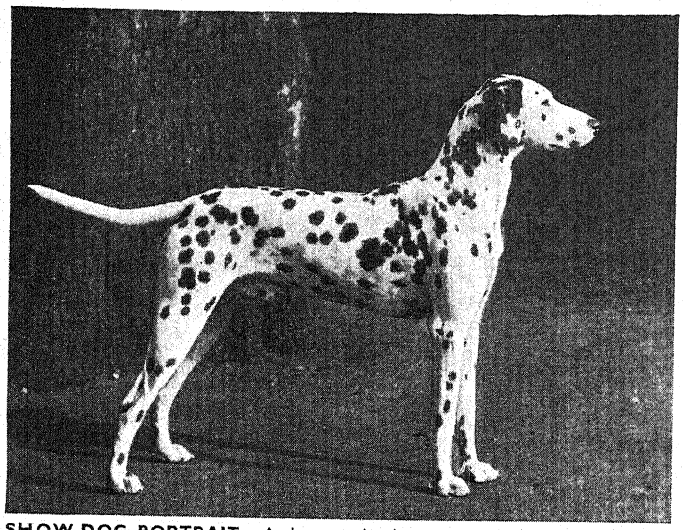
Should the lens be of long focal length, or very narrow angle, a telephoto lens, for instance, then very much the same effect will





GROUP STUDIES OF PEDIGREE SPECIMENS. Background and lighting were carefully selected for these two pictures so that the texture of the dogs' coats was brought out to the fullest extent. The Sealyhams in the upper photograph were photographed on a stone step, which gave the requisite unobtrusive background, and the lighting was subdued to avoid harsh rendering of the colour and texture of the hair. Soft lighting was also employed for the lower picture, with the result that the characteristic silkiness of the Saluki's coat is finely and delicately recorded

Photos, Thomas Fall



SHOW-DOG PORTRAIT. A photograph taken specially to reveal the points of a show-dog, particularly the lines and proportions of the feet, hind legs, tail and neck
Photo, Thomas Fall

be seen, as is noticeable in press pictures of cricket, when the bowler seems to be too close to the batsman. This distortion will be very much in evidence in the photograph of a dog. The head and front will not appear to belong to the body and hindquarters; or if the picture is of the head only, then the muzzle and foreface will be out of proportion to the eyes and ears, and possibly out of focus as well, and the front of the face will appear exaggerated. If these facts are borne in mind when selecting the lens to use, then the first steps towards the making and taking of good photographs of dogs will have been made.

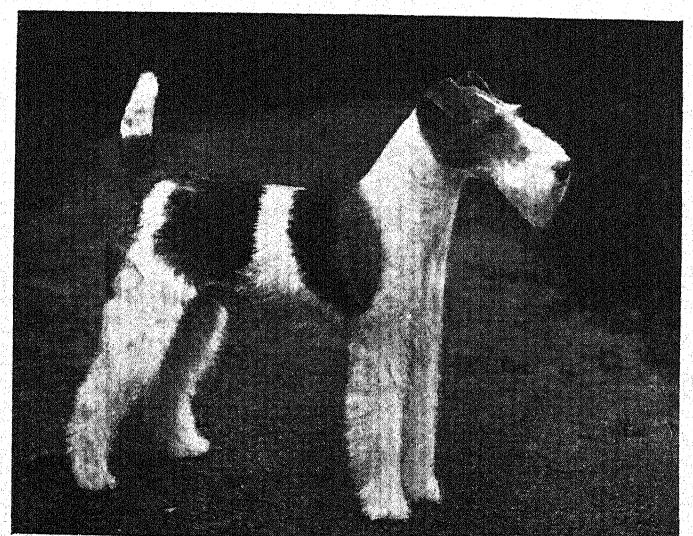
Camera Choice. As regards a camera, the reflex or twin lens camera with a full size focussing screen, shielded by a hood that can be looked down into, is a very suitable type. Its great advantage is that it can be held waist-high, which is a good viewpoint for most dogs, and unless the subject is a very small dog on the ground level, the lens will be at about the correct height.

There is, however, a small "time-lag" with the reflex camera, caused by the exposing lever having to move the mirror out of the way before the shutter acts, and this makes such a type unsuitable for action photographs. This slight delay does not occur with the twin lens reflex camera.

Another type of camera which is used largely by press men has a full-size view-finder on top. The camera is held pressed against the face, or rested on the raised shoulder.

The miniature camera has its advantages also; the coupled range and view-finder gives a concentrated view of the subject, which can be watched during exposure, to the exclusion of any distracting surroundings. A fitting can be supplied with some types of miniature camera that enables several exposures to be made in quick succession by a trigger release instead of having to wind on the film after each exposure. Three or four pictures can be taken in a second or two, which is a great advantage as dogs so often change their expressions and spring into positions immediately the snap has been taken.

There is a big variety of lenses made for this type of camera, many of them of suitable focal length for dog photography. Both the press camera and the miniature



PLACED FOR SHOWING. Another example of show-dog portraiture. In this work knowledge of the schedule of points for different breeds is essential so that the dog is depicted to the best advantage
Photo, Thomas Fall

camera have to be held up to the eyes, and as this gives too high a viewpoint for dog photography, it is necessary to bend down or drop on one knee when taking the photograph, if the dog is on the ground, or on a low bench. Failure to get the correct viewpoint will cause distortion in the resulting picture, especially if a very small film is enlarged up to about eight or ten inches. Too high a viewpoint makes a dog look short on the legs.

Lighting. Lighting of dog photographs is very important. Direct sunlight is not advisable, even when the sun falls on the subject at the correct angle. The shadows cast are so strong that the shape and often the colour of the dog are altered too much. Smooth-coated dogs can look angular and skinny; long-haired ones can have silkiness of coat exaggerated to look as if the coat were wet or oiled; soft-coated dogs can look wiry; and a wiry coat look too coarse.



HEAD STUDY. An important point in taking a close-up of a dog is the means whereby his attention is aroused. While sounds and movements are required to fix his interest, they should not be so pronounced as to excite the subject unduly. Here is a fine study of a lively wire-haired terrier taken with the camera at close range

Photo, K. Reitz

A white dog photographed in strong sunlight can look like a black-and-white one, so heavy will the shadows be, and a black or red dog can look almost white in places where the sunlight catches the gloss on the coat. The best pictures of a dog can be taken on a dull day, when the light is not too strong, but with the source of light at an angle of about forty-five degrees, preferably on the hindquarters. Too much top lighting must be avoided, as it will make smooth-coated dogs look lean and out of condition. Do not take photographs *under* the shade of trees, though the very edge of the shade cast by tall trees can be a good outdoor studio, especially if the dog looks towards the shade, and not towards the open light.

The shadow cast by a wall or a house is helpful. Try to arrange for the camera, dog, and background to be all in the shade, and do not let the dog face the mass of light, or the eyes will be flooded with too much light. It is very difficult to see to focus on the screen of a reflex camera if the sun is striking round the corner of the hood. A hazy sunshine is often a good light to take photographs in, it gives a sparkle to the picture. When the sun is low good effects may be obtained, but the dog should not face sunlight that will produce a beady light eye.

If dog photography is attempted indoors, close to a large window is a good place. Auxiliary lighting can be used in the shape of a five-hundred watt flood-light in a reflector; not a spot-light, as it is too much like sunlight. Dogs are very susceptible to the heat from these lamps and soon begin to pant. Many do not like strong electric lights.

Background. The photographer must study the relation of colours in choosing his background, which should be subdued and

unobtrusive. There should be sufficient contrast to bring out the special features of his subject. Beauty of outline, for instance, can be clearly brought out by using a contrasting background, but the expression in a head study can be better obtained by merging the outlines into the background and concentrating the lighting on the features of the face.

Avoid flower-beds, shrubs and trees, which even if in the distance can appear as if they were growing out of the back or head of the dog when they come on the outline. Sometimes when both the camera and the dog are in the shade and the sun is on the background, it will strike distant objects and bring them in appearance close up to the dog. A laurel hedge, or ivy-covered wall well away in the distance, in the shade, will look like nothing in particular; but in the sunshine each leaf is a mirror and they will look like a mass of spots.

A well-cut lawn is a good plain background for many breeds, if there are no daisies or fallen leaves on it. Light grey, white, and fawn-coloured dogs stand out clearly, as the grass photographs darker than the dog. When grass is used as a background for black and dark grey dogs, it photographs lighter than the dog. Browns, reds and golden colours do not photograph well against grass, and in a subdued light will merge into it too much. For these colours, a light roadway or gravel path, cement or rough-cast walls, is more suitable. Almost any coloured dog will photograph well on a stone terrace, or lying down on grey steps, provided, of course, the light is good.

Iso. or Pan. Generally panchromatic film is not really necessary. It is apt to give an exaggerated rendering to the colours of the coat, so much so that the effect is not seen by the human eye in the same degree, and a better rendering of the colours can be obtained on ordinary orthochromatic film. Panchromatic film should be used when photographing breeds in which the red, yellow or golden colour predominates; for instance, use orthochromatic film for a *black* cocker and a panchromatic for a *golden* cocker, and the distinction in colour will show clearly. Lemon and white will require panchromatic film or the rendering will be the same as a black and white.

Posing. If attention is paid to the foregoing points it should not be difficult to obtain good photographs of pet dogs. They can nearly always be made to obey the instructions of their owners. A good plan is to find out some familiar attitude they adopt when in their own homes, and try to get them to assume this in the selected spot that is serving as a temporary studio; then obtain the final expression by getting the owner to say or do something to attract the dog's attention without causing it to move. Sometimes it is better for the owner to disappear from view, and the mere sound of his voice in the distance will bring that bright listening look that photographs so well.



FACIAL EXPRESSION. In order to obtain this picture of a dog in pensive mood subdued lighting was employed. Brighter illumination would have distracted the animal and the fine tranquil expression in the eyes would have been lost
Photo, Thomas Fall

Dogs that are easily excited need very quiet methods; ball bouncing and throwing stones often excites them so much that the tongue begins to hang out and the tail to wag. Dogs that are excited



SETTERS IN ACTION. For obtaining action photographs of dogs such as the above a miniature camera equipped with a telephoto lens is admirably suited. The two setters, as is clearly shown, were intent on their work in the field, and the photographer stood at a distance so as to avoid disturbing them

Photo, Thomas Fall

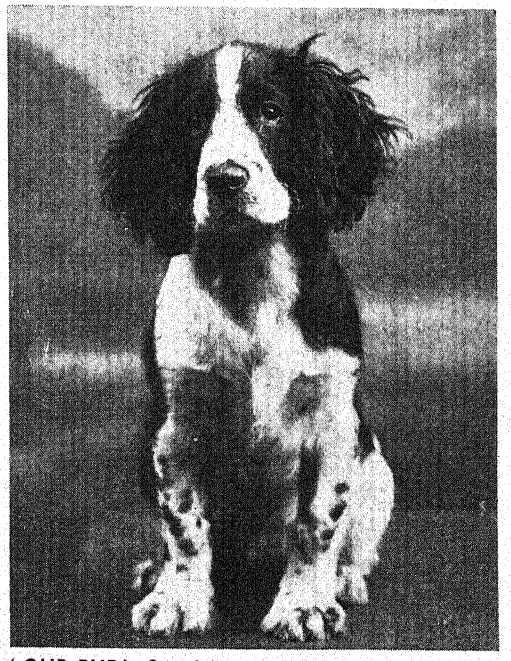
beyond control and will not shut their mouths can often be subdued and made to shut them temporarily by touching the tongue with a cut lemon or squeezing a little of the juice on the side of the mouth. The effect should be watched carefully, as some dogs sulk at once with this treatment. Should a dog's tongue become elongated so that it protrudes and curls up, give up the idea of getting the mouth shut and give the dog a long rest. As a last resort a piece of thin black silk can be tied round the mouth, but never do this with an old dog.

The photographing of show and pedigree dogs is a much more difficult proposition; it has become a highly specialized art since the number of breeds that are now recognized and shown at all the principal dog shows has increased to about eighty or more.

Each breed has its schedule of points, and every owner of a pedigree dog wants all its good points shown in the photograph, and any bad points hidden or toned down to invisibility. The photographer must be fully acquainted with these points.

In some breeds the ears, for instance, should be forward, up, and either pricked or V-shaped, while other breeds should be portrayed with the ears laid back and close to the head. Some should carry their tails over their backs, straight, others with a nice curl, while many carry their tails smartly up and at right angles to their backs.

The photographer should therefore get all his instructions well memorized before he



'OUR PUP.' One of the simplest but most attractive poses for dog portraits is seen in this photograph of a spaniel pup. Care must be exercised, however, to avoid distortion through adopting too high a viewpoint

Photo, Thomas Fall

starts work. Generally speaking, the dog should be standing up. If in profile, all four legs should be seen, with the front leg that is farther from the camera slightly in front of the other, and the hind legs similarly positioned.

Terrier Breeds should always look intensely interested, stand right up on their toes, with very straight front legs, not wide apart, level backs, tails well erect. Head and neck well up and not poking in any way.

The Big Breeds should look big in the photograph ; they should stand soundly in front, legs straight, not stretched out, leaning back ; not too close together. They should not dip in the back nor look stiff on the hind legs ; a graceful, natural position, with the hind legs not too wide apart.

The photograph should always give some idea of the correct size of the dog portrayed. Fill out the margins for a big dog, and show plenty of " surround " for a small dog. Size is very important in show dogs.

Toy Dogs should look small, and there must be no trace of shyness or nervousness shown in any dog photographed, smart and alert though small ; and as their faces are so small special attention must be paid to the eyes or they will hardly show.

The best way to set about photographing a show dog is to get the owner to place or set up the dog in front of the camera, much as one would in front of the judge in the show ring. Having done this, someone else attracts the attention of the dog in the right direction ; giving the owner time to slip clear ; immediately he is clear " snap " and the picture is taken.

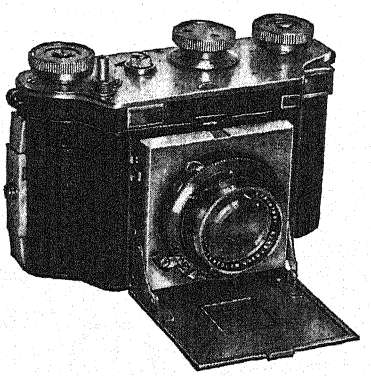
Sometimes the head and front are good in one photograph and the hindquarters and tail good in another. Prints can be made from both positions, cut up and joined together. The resulting combined picture can then be re-photographed.

DOLLINA CAMERAS. Among miniature cameras taking a 36-exposure length of cine film and giving pictures 36 × 24 mm., the Certo " Dollina " range, of German origin and marketed in this country by Messrs. Actina, Ltd., has a considerable reputation.

The latest model, the Dollina III, incorporates the following features : Built-in coupled range-finder, shutter release on top of the camera body, built-in view-finder, corrected for parallax ; prevention of double exposure by automatic coupling of shutter release and film winder ; automatic exposure counter, and depth of focus table. The lens front is carried on a folding baseboard. Focussing is carried out by means of a coincidence type range-finder.

The back of the camera is hinged for loading, the cassette is dropped into the spool chamber and the rewinding knob is engaged with it. The tapered end of the film is inserted in the slit of the take-up spool and the film drawn taut. After each exposure the film winder is released and the film is wound on until the mechanism automatically locks.

The Dollina III is finished in black leather and all metal parts are chromium plated. The camera is available with Xenar *f*2·8, Tessar *f*2·8, or Xenon *f*2 lens, according to price, and is fitted with a Compur (1/300) or Compur rapid shutter speeded to 1/500 sec.



Certo " Dollina " miniature camera with wide-aperture lens and Compur shutter

The dimensions of the Dollina III are $4\frac{3}{4} \times 3\frac{1}{8} \times 1\frac{7}{8}$ ins., and the weight is $19\frac{1}{2}$ ozs.

The Dollina II is similar in general design to the Model III, except that the range-finder is on top of the camera body instead of being completely built-in, and that the camera lacks certain refinements of the higher-priced model.

DRYING NEGATIVES AND PRINTS. The process of drying a negative after washing is quite straightforward. Nevertheless there are a few simple precautions which should be taken. After taking negatives from the water, shake off as much surplus moisture as possible, and wipe the back with a piece of dry rag. When the negatives have been placed on the rack, the bottom corner of each should be lightly touched with a piece of blotting paper to draw off any accumulation of water as quickly as possible.

There are drying racks on the market which are ill-adapted for the uniform drying of plates. The negatives are so close together that it is difficult for the air to circulate freely between them. The result of this is that not only do the plates take a long time to dry, but they dry unevenly, and this gives rise to so-called " drying marks "—variations of density from top to bottom of the negative. It is advisable to use only each second or third groove.

Roll-film, on removal from the water, should be carefully wiped front and back with either a piece of damp wash-leather or a viscose sponge, to remove all surplus moisture. If drops of water are allowed to remain on the film these will show, after the film has dried, as circular " drying marks " of greater density than the rest of the film.

Both plates and films should be left to dry in an airy but dust-free place, since dust adheres only too readily to the moist gelatine. The quicker the film dries the better, since every moment that it remains wet it is liable to accident, but care should be taken not to place negatives too near a fire to accomplish this. Under excessive heat the water-laden gelatine will easily melt.

Care should also be taken, when drying spools of roll-film, that a sudden draught does not blow them into contact.

Rapid Drying. Plates or prints can be dried rapidly by soaking in two baths of methylated spirit containing 10 per cent. water, and then placing in an air current.

For drying roll-films rapidly after the final washing, pass them backwards and forwards through a 10 per cent. solution of formalin for two or three minutes and remove the surface moisture. Considerable heat can then be used to dry the films quickly.

Never attempt to dry films by repeated immersion in methylated spirit, as this will cause the celluloid base of the roll-film to cockle.

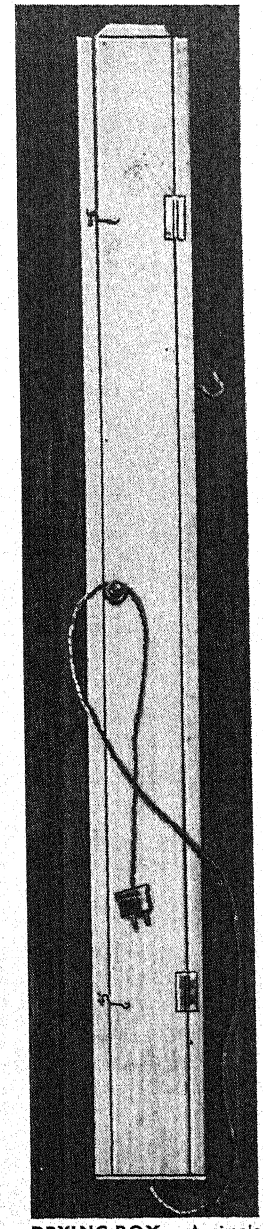
Removing Drying Marks from Film. The negative should be completely bleached through in a bleaching solution made up of:

Potassium bromide	10 grs.
Potassium ferricyanide	10 grs.

to each ounce of water. After bleaching, the negative is washed and then fully redeveloped in a non-staining developer.

Drying-Box for Roll-Films. The device here described and illustrated is easy to make and very useful to the user of roll-films, for not only does it reduce the time required for drying but also safeguards the film from damage and makes the settlement of dust particles on emulsion almost impossible.

It consists of a long wooden box, open at both ends and with the front hinged to swing clear. Inside, at the top, is mounted a steel pin, set in a wood block half an inch thick (this is to prevent the film hanging too close to the back). On this pin is hung one of the special clips made for gripping the ends of films, while a similar clip, but weighted with one ounce of lead, is kept for the lower end.



DRYING-BOX. A simple device for drying roll-film. An electric bulb is used for warming the air within the box that contains the film

At the base of the box is mounted an electric lamp, and the whole is fixed to any convenient wall near an electric light plug.

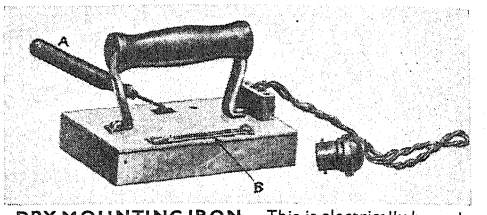
In practice the clips are put on to the ends of the strip of film after this has been wiped down, the top clip passed over the pin, the front closed and the light switched on. The lamp, being so mounted that it lies just inside the base of the box, gives off heat which causes a current of warmed, but not hot, air to travel upwards and past the film. This rate of travel of the warmed air, while not fast enough to create an actual

draught and thus suck in dust, is yet enough to keep a movement of freshly warmed air passing up along the whole length of the film. If the film should be urgently needed for any particular reason, it can be first bathed in methylated spirit, when the time taken for drying will be much shortened.

The box illustrated in p. 607 was made to take the ordinary eight-exposure $3\frac{1}{4} \times 2\frac{1}{4}$ film, and measures 3 ft. 9 in. long, 4 in. wide and 3 in. deep. To prevent flies attracted by the light of the lamp from entering and walking over the films, both open ends are covered with perforated zinc. An 18-watt lamp will be found ample, and there is no risk of frilling the film or of its catching fire.—*W. R. LEE.*

DRY MOUNTING. This is a process for mounting photographs and prints of any kind perfectly flat on any kind of support. Between the print to be mounted and the card or other support a thin sheet of tissue paper impregnated with shellac is placed. The tissue should be very slightly bigger than the print to be mounted. Heat and pressure are applied, under which the shellac melts and firmly cements the print to its mount. It is a rapid and convenient process, and there is no risk of damaging ordinary prints; no moisture of any kind is required.

When carried out on a large scale, expensive machines, gas or electrically heated, are required; but the amateur can obtain good results with the ordinary flat-iron. Dry mounting tissue is sold in the standard sizes of photographic papers and can be obtained from photographic dealers. To mount a photographic print by this method, take a sheet of dry mounting tissue and lay it flat upon the back of the print. By rubbing the tissue lightly with the back of a hot spoon it can be attached to the print.

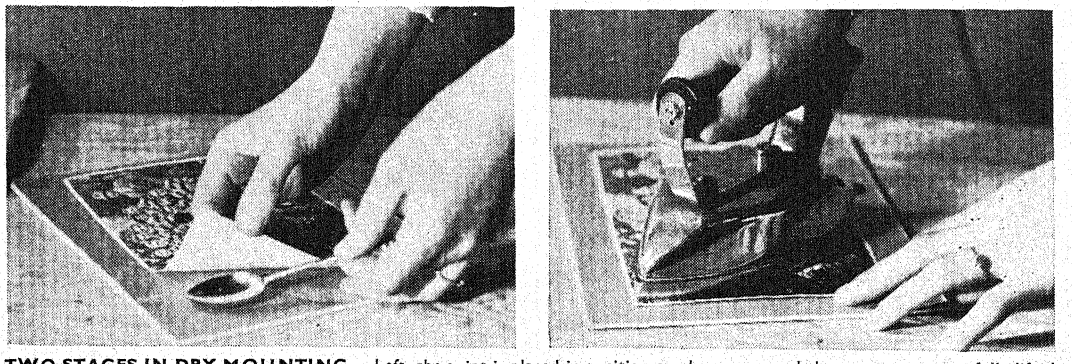


DRY MOUNTING IRON. This is electrically heated and fitted with detachable iron and thermometer
Courtesy of the Adhesive Co., Ltd.

Lay print and tissue down on the mounting card in its right position (previously determined), lift the print and touch the tissue at the bottom corners with the hot spoon, so that it adheres to the mounting card. The print is now ironed all over with an iron heated to such a temperature that water applied to it sizzles slightly, *i.e.* it should be just above the temperature of boiling water. If the temperature is not right it will be impossible to carry out the mounting process successfully.

A very convenient form of iron for dry mounting is the electric one shown in the photograph. It has included in it a thermometer, B, so that precisely the right temperature may be obtained without trouble. At A small iron is inserted, with which the corners of the tissue are touched to make them adhere to the mounting board. The iron is also available for the domestic laundry purposes.

The print should be covered with a sheet of thin tin or a piece of brown paper which has previously been well ironed on both sides, and the heated iron then applied with con-



TWO STAGES IN DRY MOUNTING. Left, the print is placed in position on the mount, and the corners are carefully lifted up while the tissue is stuck to the mount with a hot spoon. Right, the trimmed print is pressed down with a warm iron. If the iron is too hot the print will come away from the mount; if it is not hot enough to melt the tissue the print will not adhere. A polished iron may be used direct on the print

siderable pressure for about 15 or 20 seconds, moving it about so that each part of the print obtains heat and pressure. If the print is a large one the ironing will have to be done in portions. If correctly carried out the print should adhere firmly all over, be perfectly flat, and have no tendency to cockle. If the print adheres to the tissue but the tissue does not adhere to the card, the iron was not hot enough. But if the tissue adheres to the card but not to the print, the iron was too hot. It is a simple matter to repeat the process until the right temperature is found.

Another method of dry mounting uses a mountant, which is made up as follows :

Finely powdered white shellac	2 ozs.
Borax	5 drs.
Sodium carbonate	1 dr.
Water	7 ozs.

A jar containing the 7 ozs. of water is placed in a saucepan half full of water which is brought to the boil. The borax and soda are then dissolved and boiled for 5 minutes. Next add the shellac gradually, stirring continually; boil the whole for an hour and stir.

DUPLICATE FILM. Introduced in 1937, this film is coated with a special emulsion which works by solarization, so that if it is not exposed to light it develops completely black, and wherever it is exposed to light the opacity is more or less reduced according to the exposure received. This means that it will reproduce either a negative as a negative or a positive as a positive. Copies may be obtained by contact or by enlargement. Fairly high-intensity illumination is required in the enlarger as the speed of the material is relatively slow.

For those who are handling the material for the first time, it is suggested that a careful test strip be made, with a series of graduated exposures both above and below those given by the manufacturers. In this way some comparison can be obtained. The question of contrast is an important one, and unless care is taken to get a fairly accurate exposure, coupled with full development, it will be found that the contrast will build up excessively, and it will not be possible to retain the full scale of gradation which may exist in the original. While this is not of such great importance in the case of a positive, perhaps, it is an essential matter in making duplicate negatives. The most suitable developer is an ordinary metol-hydroquinone-carbonate such as is used for ordinary bromide papers. Development should be complete in about five minutes at 65° F., although if it is continued up to as much as eight minutes the duplicate will tend to be of a more brilliant character. If the duplicate is too thin and much weaker than the original, then the exposure time is too great; while should the duplicate be much denser than the original and of a clogged appearance, then the exposure time must be increased.

The image obtained on the duplicate film is exactly the same as any other photographic image, and may be treated accordingly, *i.e.* it may be intensified or reduced as may appear to be necessary. However, it will be obvious that after-treatment of the duplicate will not give such good results as if the correct exposure and development had been given in the first place.

STANLEY W. BOWLER, A.R.P.S.

DUPLICATING NEGATIVES. There are various methods of duplicating negatives and transparencies, and sometimes more than one reason for desiring a duplicate.

Broadly speaking, there is often a slight falling off in the general quality of any copy, which, particularly with some methods, is often present in duplicate negatives. It can be taken for granted that a copy cannot improve on a good negative, and often fails to preserve the subtle tones and photographic atmosphere of the original; but, on the other hand, it is often a means of increasing the contrast of a weak negative, or a method of adjusting the density and printing contrast of a subject required for specialized work. Enlarged negatives are of service for making contact prints from processes which for technical reasons do not lend themselves to direct enlargement, and enlarged duplicates from miniature negatives are useful where retouching or working-up is required.

Sometimes, in making very big enlargements from miniature negatives, it is helpful to expose the final print from an enlarged negative, instead of working from the original.

Duplicate Negatives By Contact Printing. The most usual method of duplicating a negative in the same size is to make a contact transparency or positive from which a second contact negative can

be taken. If the intermediate positive is made on a very slow emulsion, an increase of contrast can be effected if desired, and a further increase can be added in the next step of exposing the duplicate negative.

The best intermediate positives are those which are full of detail and rather soft in general character. For this reason over-exposure must be avoided, as, if any portion of the picture becomes clogged, the defect will be emphasized in the second exposure.

Making Duplicates Through the Enlarger. Duplicate negatives, in any reasonable size, both by reduction and enlargement, can be made through the enlarger, by first exposing the original on to a slow film or plate which takes the place of the usual bromide paper. Very brilliant illumination should be avoided in order to minimize the chances of light scatter, and it is sometimes an advantage to make the exposure through an appropriate colour filter, or a pola screen.

Copy Duplicates. When a negative is carefully illuminated from behind, preferably by reflected light, the camera can be used to expose a positive, which in its turn can be employed for printing a duplicate negative, either again by transmitted light and the camera, or by any of the methods already described. This method is often helpful when the original has been retouched, or if there is any reason to apply local control, which can be effected by shading the light behind the illuminated transparency. In miniature camera work this arrangement, effected by means of one of the devices provided for photographing in the same size, or by low magnification, where the original negative is arranged in the subject-frame and is lit from behind, will prove a rapid and convenient means of duplication.

Duplicating By Means of a Print. The photographic quality of any copy negative made by photographing a print is often disappointing. As a general rule glossy prints are to be preferred, and great care must be taken in the lighting arrangements to avoid reflections. With matt paper, the surface reflection, or specular reflection as it is termed, will reduce the light absorption apart from the danger of the paper texture being registered. If on the careful arrangement of a smooth surface matt print the illumination is by polarized light, which is controlled by a pola screen over the camera lens in a crossed position (*see* Polarized Light), such complete light absorption is possible by the darkest portions of the print, that due to an efficient means of eliminating specular reflection from the surface, excellent duplicates can be obtained this way.—*BERNARD ALFIERI, JR.*

See Duplicate Film.

DYES USED IN PHOTOGRAPHY:

J. D. Kendall, Ph.D., B.Sc., A.I.C., D.I.C.

Head of Dye Research Laboratory, Ilford, Ltd.

In the manufacture of modern photographic material, dyestuffs of differing kinds are very extensively used. Much of the progress that has been made in photography is due to the incessant research associated with dyes, and as fresh advances are made so do dyestuffs become more important in photographic processes. What these materials are, what their characteristics are, and how they function are explained in the following article

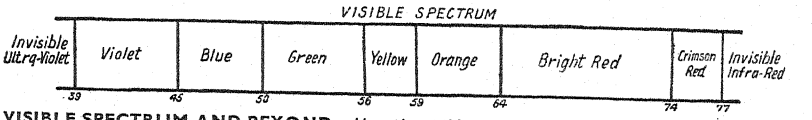
See also Colour Photography; Desensitizing. Dye-Toning.

AMONG the many purposes for which dyes have been employed in photography, the following are the most important:

1. Colour sensitizing of photographic emulsions.
2. Manufacture of light filters.
3. Manufacture of dark-room safelights.
4. Preparation of anti-halation layers.
5. Making colour plates, films and prints.
6. Desensitizing of photographic emulsions.

The use of specific dyestuffs as desensitizers for photographic materials is discussed under Desensitizers; the functions of dyes in the other processes are given below.

Dyes in Colour Sensitizing. The range of colour sensitivity of photographic emulsions is normally very limited. Silver chloride emulsions used chiefly for gaslight papers are sensitive to ultra-violet only, whilst silver brom-iodide emulsions, forming the basis of most negative materials, have their sensitivity for normal exposures almost



VISIBLE SPECTRUM AND BEYOND. How the visible spectrum is split up into various colours, all of which are registered by the human eye. Beyond this range are the ultra-violet and infra-red rays

completely in the ultra-violet, violet and blue portion of the spectrum (Fig. 1). Since, however, the human eye is sensitive to all colours in the visible spectrum (most strongly to the yellow green) (Fig. 2), and is completely insensitive to light below certain wavelengths in the violet and above others in the far red, the impressions of many coloured objects recorded by such photographic emulsions must of necessity be entirely different from those registered by the eye.

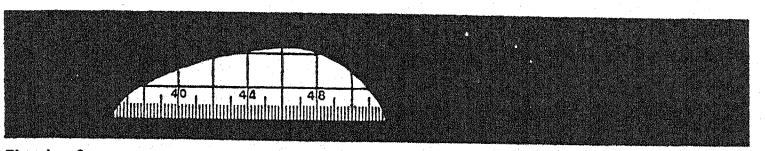


Fig. 1. Spectrogram of a typical non-colour sensitized negative emulsion. Sensitivity is in the ultra-violet, violet and blue portions of the spectrum only

Thus, for example, greens, oranges and reds, when photographed by ordinary negative emulsions of the silver bromiodide type, would receive completely erroneous tone values compared with those obtained visually. Bright green fields and trees in landscapes would be represented as dark areas instead of bright light ones, whilst an orange object on a dark blue background would photograph as a dark object on a light background instead of the reverse, as seen by the eye. Reds, in addition, would always be recorded as blacks by the non-colour sensitized emulsion, plate or film.

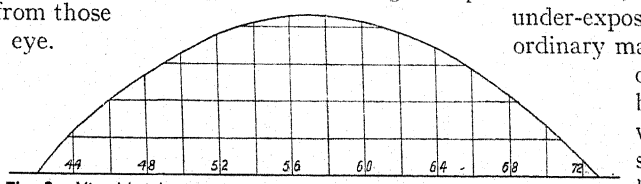


Fig. 2. Visual brightness curve indicating degree of sensitivity of the human eye to the various colours

Extension of Colour Sensitivity. By the use of certain dyestuffs, known as sensitizing dyes, it has been found possible to extend the limited ranges of sensitivity of these emulsions towards the red end of the spectrum with advantages which can easily be recognized when the results are considered. The extension of colour sensitivity into the green (Fig. 3) by what are known as *orthochromatic dyes* immediately gives partial correction of erroneous green tones resulting, for example, in brighter landscapes. Orthochromatism, too, enables the plates and films to be used for outdoor photography when the light is poorer in blue, with less risk of under-exposure than with ordinary materials. Yellow, orange and bright red colours would, however, still be incorrectly reproduced by orthochromatic materials, and it is only by extending the sensitivity of the emulsion still farther into the orange and red (Fig. 4) by means of *panchromatic dyes* that some correction for these colours is obtained.

Complete correction of tone values merely by colour sensitizing is not possible, since panchromatic plates and films still possess a high blue and violet sensitivity which the eye does not have, and in addition most panchromatic materials are more sensitive to red light relative to green than is the eye. (Compare Figs. 2 and 4.) By means, however, of selected light filters, correct colour rendering in monochrome can be obtained.

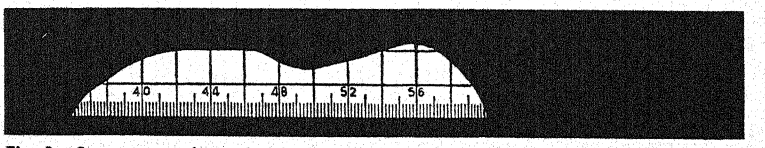


Fig. 3. Spectrogram of typical orthochromatic emulsion. The use of certain dyestuffs gives an increase in the range of sensitivity

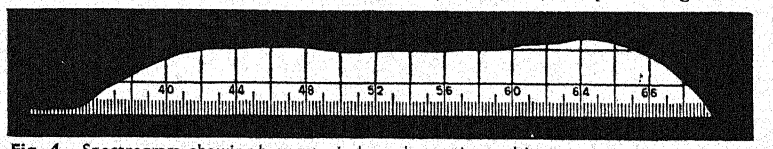


Fig. 4. Spectrogram showing how a typical panchromatic emulsion possesses a greater range of sensitivity than the orthochromatic emulsion

Apart from the advantages of better

colour rendering, panchromatic materials are invaluable for photography by artificial light. Electric light, for example, is much richer than daylight in orange and red light. The result is that although the speeds of both ordinary and panchromatic plates and films are similar in bright daylight, the panchromatic material with high orange and red sensitivity is relatively very much faster to the artificial light. Panchromatism in the film is, therefore, of great importance to the film industry which uses high-power electric lighting and requires a very fast colour-sensitive film.

The development of present-day infra-red photography, with its numerous applications, is another example of the use of sensitizers, a silver bromiodide emulsion, which is completely insensitive for normal exposures to the invisible infra-red, being made sensitive by means of specific dyestuffs.

Various Uses of Dyestuffs. In addition to their use for colour sensitizing negative materials, dyestuffs may also be employed to increase the colour sensitivity of positive materials, *e.g.* chloride or chlorobromide papers. Since the range of sensitivity of silver chloride emulsions is almost completely in the ultra-violet, gaslight papers are extremely slow working when used for printing by electric light in which ultra-violet radiation is low. By the use of sensitizing dyes, however, the sensitivity of chloride emulsions may be extended throughout the violet and blue, with the result that chloride papers with speeds approaching those of bromide papers may be readily prepared.

Chief Dyes. The dyes in use in commerce fall, in the main, into several well-known classes, chief of which are the cyanines. Unlike other chemicals employed in the photographic industry, sensitizing dyes are the products of the research laboratories of the manufacturers of photographic materials, and the formulae of most of the dyes in actual use are strictly secret. The selection of any dye for a specific purpose, from the numerous dyes available, is not a simple matter, as the dye must fulfil many requirements.

Some dyes tend to cause fog in the emulsion, while others are unstable and cause the emulsions to lose colour sensitivity too readily. The choice of sensitizers for certain materials, *e.g.* orthochromatic plates and films, again is restricted to those giving emulsions which are not readily fogged by the red safelights in general use.

Colour Sensitizing. The colour sensitizing of an emulsion may be carried out either by bathing the undyed plate or film in a weak solution of the dyestuff, or by incorporating the dyestuff in the emulsion. In practice it is found that, utilizing the dyes now available and the modern technique of emulsion making, the best results are invariably obtained by addition of the dye to the emulsion. Bathing, indeed, is to be recommended only in exceptional circumstances where the dyestuff is very unstable. In the case, for example, of certain infra-red dyes which lose their sensitizing power rapidly in emulsions, bathing the unsensitized plate or film just before use is preferable. For the best sensitizing effect the amount of dyestuff required is found to vary with the dye and the emulsion, but it is small compared with the quantity of silver salt present.

For the photographer who wishes to carry out his own colour sensitizing by bathing, a number of dyes are available. These include orthochromatic, panchromatic, and infra-red sensitizers, and certain of them are obtainable from the leading British manufacturers of photographic materials.

In general the dyestuffs are employed at very low concentrations in aqueous alcoholic solution, and the undyed plates sensitized by bathing for about three minutes and then carefully drying. The alcoholic solution used should preferably contain less than 30 per cent. of alcohol, so that penetration of the emulsion does not become too slow, and bathing should be carried out either in complete darkness or by a light to which the sensitized material alone is safe.

The mechanism of colour sensitizing by dyes is still a matter of conjecture. It is known that certain classes only of dyestuffs possess the property of extending the range of colour sensitivity of photographic emulsions and that with these dyes there is a close relationship between the colour of the light most strongly absorbed by the dyestuff and the colour at which the extra sensitivity reaches a maximum. This sensitizing maximum is usually near the absorption maximum, but displaced towards the longer wave, *i.e.* red, end of the spectrum. The view

generally accepted is that the dyes are absorbed on to the silver salt in the emulsion.

Dyes for Light Filters. As has been mentioned previously, the correct tone rendering by a photographic plate or film of any subject possessing a variety of colours is not possible, even with panchromatic materials, because of the excessive sensitivity of the emulsion to ultra-violet, violet and blue radiations. By the use of suitable yellow dyes which absorb these radiations to various extents, it is possible to prepare light filters which, when used in front of the lens of the camera, reduce the over-emphasis in the negative of colours which the eye cannot see. Such correction filters, which give complete absorption of the ultra-violet and partial absorption of the violet and blue, are prepared from gelatine solutions of dyes of the Filter Yellow K and Tartrazine types.

The precise composition and intensity of the dyed layer in the filter varies according to the purpose for which it is required, several types which give various degrees of colour correction with panchromatic materials being available commercially. For complete correction of the colour impression obtained with a panchromatic plate or film, a greenish yellow filter made from a mixture of dyes is necessary. The function of this mixture is to reduce not only the ultra-violet, violet and blue radiations entering the camera, but also the red light to which panchromatic materials are somewhat more sensitive than is the eye.

Yellow filter layers are also of value in overcoming the obscuring effect of haze or mist which is produced by the scattering of light by small particles suspended in the air. A very pale yellow filter with a panchromatic plate or film possesses good penetrating power. In all cases, however, the use of a filter increases the period of exposure.

In the preparation of filters for other specific purposes, *e.g.* colour separation negatives for colour printing, dye mixtures with the properties of selective absorption (or, conversely, transmission) of parts of the spectrum are utilized. For a suitable filter transmitting red, a mixture of such dyes as Rose Bengal and Tartrazine has been recommended, while for the green filter a mixture of Naphthol Green, Patent Blue and Tartrazine, and for the blue filter a mixture of Acid Rhodamine and Toluidine Blue may be used. In the case of infra-red plates and films, too, when it is essential that only the infra-red sensitivity be utilized in photographing the subject, a selection filter is employed. This is prepared from a special dye mixture which absorbs light from the whole of the visible spectrum. Precise details of the composition of the dye materials used for filter work are available in the case of a number of standard filters only, and can readily be obtained from textbooks. Formulae, however, of dye mixtures for all other filters are manufacturers' secrets.

Dyes in Dark-Room Safelights. The dark-room safelight is a special type of light filter whose object is to absorb light of a colour to which a specific photographic material is unsafe, and to transmit light only of a colour to which the material is comparatively insensitive. Like other light filters, it consists essentially of dyed gelatine layers mounted between glass plates. In selecting dyes for a safelight, the extent to which the light transmitted is safe for a given material is not the only factor which counts. Since the purpose of the safelight is to enable the operator to handle his materials with as much light as possible, the visual intensity of the light is also important. Thus, where a given material is safe to both orange and red light, an orange safelight is to be preferred to a red safelight with the same safety factor, since the light from the former appears much brighter to the eye.

Many of the dyes used for safelights are well-known commercial products which have also been used for light filters. Dyed gelatine layers of Tartrazine and Rose Bengal, for example, used in combination, give an orange safelight by which bromide papers can be developed in safety, while a mixture of Naphthol Green and Filter Blue may be used in preparing a dark green safelight for use with panchromatic plates and films. Other dyes which can be used for safelights are Naphthol Orange (for bright yellow safelights), dark-room red (for red safelights) and dark-room green (for green safelights other than for panchromatic materials).

Dyes in Anti-Halation Layers. Halation due to the reflection and resultant scattering of light by the glass or film support can be considerably reduced by backing the plate

or film with a dyed layer which absorbs light of a colour to which the emulsion is sensitive and reflects only that to which it is comparatively insensitive. Ordinary and orthochromatic plates and films, for example, are usually backed with a layer of a red dye, while for panchromatic materials a blue-green backing is generally employed. Although the ideal position for an anti-halation layer is between the emulsion and the support, in practice it is usually coated on the back of the plate or film, since most of the dyes suitable for such layers adversely affect the properties of emulsions.

The selection of dyes for anti-halation layers is not a simple matter, since comparatively few of the dyes or dye mixtures fulfil all the desired requirements. In addition to possessing the right colour, the dyestuff should preferably be completely and rapidly decolorized and destroyed during the developing and fixing processes without adversely affecting the properties of the developer. Many dyes which are easily decolorized are unfortunately regenerated by aerial oxidation on the negative after the fixing process, and are therefore useless. The solubility of the dyestuff in a suitable medium is also of importance since it is essential that an even coating of a sufficient intensity be obtained. This coating, too, when dry must not be susceptible to rubbing during handling.

The formulae of the dyes actually employed commercially for anti-halation layers are not generally available. From the patents covering the use of specific groups of dyes for such layers it would appear, however, that most are of the triphenylmethane class.

Dyes in Colour Processes. In all commercial processes for the reproduction of coloured objects in colour, dyes naturally play an important part. Every colour-print process, for example, involves the preparation of either colour separation negatives, for which dyed light filters are necessary, or of colour transparencies (*see* Colour Photography, Sections 4 to 7). Although for the colour of the prints themselves pigments are often used, a number of processes have been devised in which dyes are employed. These include imbibition, *e.g.* Pinatype and other relief, mordant or dye-toning processes, and bleach-out, such as the Utocolor processes.

In the case of imbibition processes the composition of the dyes used varies with the requirements of each process. Pinatype, for example, makes use of special acid dyestuffs which are selectively absorbed by soft, as opposed to hardened, gelatine, while for other imbibition processes both acid and basic dyestuffs are used. (Acid and basic dyestuffs comprise two of the main classes of dyes known; the former in general are more stable to light but give less brilliant colours than the latter.) For mordant processes in which dyes are fixed by suitable compounds introduced chemically in place of the silver of the normal image, basic dyes are usually employed. The colours obtained by such mordant processes are, however, generally of too high an opacity to be well adapted to colour photography, but the processes serve as a useful means of obtaining dye-toned images (*see* Dye-Toning). In the case of bleach-out processes in which prints are prepared directly from colour transparencies, special basic dyes only are used. These dyes in the unfixed state are readily decolorized, especially in the presence of certain chemicals, by light of the colour which they absorb. Due, however, to difficulties in obtaining red, blue and yellow dyes with identical rates of bleaching, and to difficulties in fixing, bleach-out processes at the moment are very imperfect.

In addition to their use in the preparation of colour-prints, dyes are also employed in all commercial colour transparency processes. Dyed filters, for example, of similar composition to those used in making colour separation negatives are necessary for both additive and subtractive processes. In the case of colour films, *e.g.* Dufaycolor, and colour plates, *e.g.* Autochrome, which employ additive processes, these dyed filters are incorporated in a panchromatic film or plate, where they act both as taking filters for the negative and, after reversal, as the colour components of the positive. The selection of suitable dyes for such processes is naturally much more difficult than that of dyes for filters used outside the camera. Thus, in addition to their colour characteristics, the dyes must be stable enough to pass unchanged through all the photographic processing involved in the preparation of the transparencies.

Among other processes of importance for colour films are Gasparcolor, Kodachrome,

Agfacolor (*see* Colour Photography, Section 3) and Technicolor. In all these processes colour transparencies are obtained by employing dyes in different ways. Technicolor (*q.v.*) is a subtractive process which employs dyes both in taking filters for separation negatives and in the colouring, by imbibition, of the final print. Gasparcolor makes use of fast dyes which are, however, readily destroyed during development wherever the silver image is formed, while Kodachrome and Agfacolor use the principle of colour development. In these latter processes the dyes are formed by the quantitative coupling, wherever the silver image is developed, of a colour former, with the oxidation product of a developer of the paraphenylene-diamine type.

The properties of the dyes required in most colour processes are so critical that their precise composition is usually maintained as a closely guarded secret by the firms concerned

DYE-TONING FOR THREE-COLOUR TRANSPARENCIES

Geraldine Geoghegan, F.R.P.S.

For those workers who possess the necessary scientific knowledge, dexterity and patience, the method of making coloured transparencies described below has a definite appeal. Based on the subtractive principle, this dye-toning provides a means of making fine, delicately coloured slides, and although the work demands skill, the equipment and materials necessary are not elaborate

DYE-TONING has occupied a prominent place in the minds of many research workers for a considerable number of years, but because it has very little to offer the commercial side of photography, actual details of the process have seldom been made available to the amateur. At the same time, it is a process that should have an appeal to the worker who has a little scientific knowledge, a profound respect for accuracy of detail, and the same respect for cleanliness of dishes, etc. This latter point may in itself sound slightly insulting to the photographer who does his own developing, but it must be remembered that he is dealing with chemicals and dyes that have a far-reaching effect if accidentally contaminated one with the other.

The process is based on the theory of three-colour subtractive photography ; three negatives are taken through standard red, green, and blue filters, and transparencies (positives) printed from each negative. A very great deal depends upon the character of these negatives for successful results. It is merely a waste of time to expect delicate slides, full of exquisite gradations of colour such as are possible by this process, to be obtained from harsh, contrasty negatives. A suitable negative must be fully exposed, and treated with a developer that gives soft, delicate detail, the highest density of which should not exceed a Gamma of 1·3.

From these negatives three positives are made on lantern plates, and a brand should be chosen with a long straight line of the " characteristic curve."

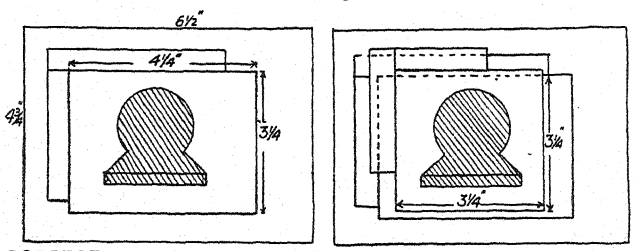
There is a very simple method to ensure easy and perfectly correct registration. The position of the red filter positive (blue printer) should be carefully selected and a positive made ; the three negatives should now be mounted on three separate sheets of glass larger than the negatives themselves (a quarter-plate on a half-plate is about the proportion) by means of a tiny spot of seccotine at each corner. Two pieces of good card for each negative are now needed, (the thickness of the glass of the latter) about three-quarters of an inch wide. One piece is placed on the top of the negative edge on the glass and the other down the left-hand side. These are kept in place on the glass with a little seccotine. The positive which was made at first from the red filter negative should be very carefully placed in register over the latter and two narrower pieces of card be stuck down, one along the top edge and one down the left-hand side and then left till set. When the positive is removed there should be a clean right angle into which the corner of a plate can be exactly fitted ; the same procedure should be carried out with the green and blue filter negative, the blue printer being used in each case.

As the positive from the red filter negative is the one which gives the drawing of the subject (blue-green positive), this is printed in contact with the emulsion side of the

negative, but in order to ensure absolute registration in the finished slide the positive from the green filter negative and the blue ditto are reversed and printed through the glass of the lantern plates; this means that special thin glass plates must be used, and this is also necessary to make the slide a reasonable thickness for the normal lantern slide carrier.

If, however, the negatives are made on film, it is better to reverse the latter and print through the celluloid. In this case it is only necessary in the registration preparation to fix the celluloid to the supporting glass and make a right-angle corner of card, thus doing away with the wider strips of card which were used to level up the glass negatives.

It is essential that these positives be developed in a non-tanning developer and fixed in ordinary hyposulphite of soda, and on no account must acid fixing be used. The washing should be extremely thorough, as the slightest trace of hypo left in the slide will be disastrous.



CORRECT REGISTRATION. Diagrams showing method of ensuring registration of positives. Left, negative mounted on sheet of glass with cardboard fixed on top and left-hand edge. Right, negative with positive placed in register

The character of these positives is very important. It should be borne in mind that each positive is not a finished slide, but one-third of a whole. It is very seldom that absolutely pure colours are met with, therefore it is possible that one colour may be represented in all three positives in varying densities; in this case the positive must be kept very pale, fully exposed, but the development should be on the short side with the image delicate but full of detail. The highest density should not exceed a Gamma of 1.0. All fog must be avoided, but the high-lights should not be just clear glass.

It must be borne in mind that whatever is recorded in each positive will be seen in the finished slide, as the mordant converts any exposed and developed silver into cuprous sulphocyanide which retains basic dyes. If time is not a great consideration it is better to let the positives dry before starting on the mordanting operations.

There are numerous mordants for converting the silver into a colourless gelatine with an action for retaining dyes, but the writer has found from experience that the following is the most successful formula:

A.	Copper sulphate	40 gms.
	Potassium citrate	60 gms.
	Glacial acetic acid	30 cc.
	Distilled water	500 cc.
B.	Potassium sulphocyanide	25 gms
	Distilled water	500 cc.

It is false economy to buy cheap chemicals; they should all be of the purest quality obtainable. The solutions keep separately for quite a long time, but when mixed speedily deteriorate.

The working bath of the mordant is prepared by taking equal quantities of "A" and "B" and using at 65° F. If used at a higher temperature, reticulation sets in; but at a lower temperature than 65° F. bleaching takes place very slowly and a hardening action of the gelatine occurs. The positives should be left in the bath for about three minutes with slight agitation of the dish, and should then present a creamy white, slightly opaque appearance. The mordant should be poured away, and a little clear water flowed very gently in from the side of the dish. At this point it is necessary to say that the gelatine surface of these positives is very soft, therefore it is essential that all solutions be carefully filtered, and the room in which the operations are taking place reasonably dust-proof. The writer uses sheets of glass to cover all dishes as a precaution against grit and dust.

The first lot of water that was flowed in should be poured away, and a second lot put in the dish in the same cautious manner. Care is necessary, since it is very easy to wash the mordant out of the gelatine, and if the water is poured on the surface of the positives themselves, a patchy appearance will result when dyeing up. After the second lot of water has been poured over the positives the dish should be left without agitation for some four or five minutes.

The image on the positives should now present an absolutely clear, transparent appearance. All trace of the creamy opaqueness should have disappeared, or otherwise the resulting slide will have a muddy, degraded colour instead of the clarity which is so characteristic of this process.

The dyes used are of a basic nature, and are as follows :

Methylene Blue	For blue-green positive.
Rhodamine B	For magenta-pink positive.
Auramine	For yellow positive.

It is wise to make a small amount of these dyes into a concentrated solution which should be very carefully filtered ; the actual dye-baths themselves are used very weak indeed, only a few drops being used to a quarter-plate dish, as staining up must take place very slowly. Five hours is not too long for the blue and pink, although the yellow is better used a little stronger, as the slide is apt to go brownish if left too long.

If the dye baths are weak enough there is no need to agitate the dish, but if too strong a mottled appearance will result which is almost impossible to remedy.

A drop or two of glacial acetic acid should be added to the blue bath, but on no account to the pink dye bath. A little citric acid added to the yellow bath will prevent the slide turning brown, but should be unnecessary unless there is some impurity in the water.

A very great deal of control can be exercised over the gradation of the blue and pink positives by washing back in clear water ; the slides are best left in clear water without agitation, and the high-lights will wash back first. They can be placed again and again in the dye baths, but the writer has noticed that if they have been left to get dry for some days the gelatine hardens and refuses to swell again to take up any more dye. It is not advisable to wash the yellow positive too much, as, even if distilled water is used, the brownish tendency can be a great nuisance.

The great thing to avoid is too dark a stain, and the writer finds it a great help to have a piece of the deepest possible permissible tint of each slide handy as a reference ; the eye gets very jaded after looking at the three colours for any length of time, and almost invariably misjudges the depth of colour necessary to each positive unless it has some key. The misjudgement is without exception on the dark side and therefore is troublesome.

The finished positives need not be balsamed but must be carefully placed in register, taking care that the pink is in contact with the blue and the yellow on the outside. A spot of very dry seccotine along the edge of the complete slide some time before it is bound up will ensure it keeping in position, and this should be allowed to become thoroughly hardened before the binding strip is put on in the usual manner.

In conclusion, attention must be drawn to the fact that the words " dye-toning " embrace a very large field in which a considerable amount of experiment has taken place, particularly now that colour photography has interested the world of professional cinematography. It has a very great advantage over screen-plate processes—first, because it is possible to make copies, and secondly, because it does not need any greater volume of light to project it by than monochrome ; in fact, monochrome slides and three-colour dye-toned slides can be projected one after the other without alteration of projecting apparatus and without discomfort to the observer.

The chief experiments have taken place in the mordants ; the one which has been set out in detail by the writer is the formula used by Messrs. Lumière and Seyewitz, and also by Dr. D'Arcy Power, and is considered by the writer to be the one most suitable for the amateur. The slides are remarkably permanent by this process and the dyes and chemicals easy to obtain. Some workers claim that it is possible, by a slight alteration in the formula, to make the mordant into one solution ; although this has undeniable advantages, the writer has not found the results so good as the two-solution method.

Experiments have also taken place in an endeavour to incorporate the dyes in the emulsions. This, of course, is beyond the reach of the amateur unless placed on the market.

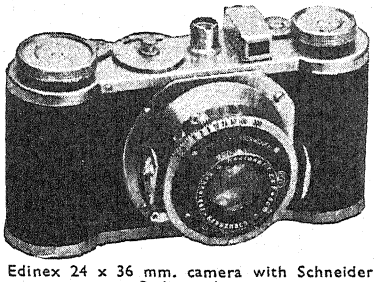
EDINEX CAMERA. This camera, of German origin, is marketed in this country by Messrs. Wallace Heaton, Ltd. It is a true miniature camera, making 36 exposures of 24 × 36 mm. size on standard cine film.

The lens, a 5-cm. Schneider Radionar of maximum aperture *f*2·9, is collapsible and is

extended for use by pulling it out by the projecting lugs, whereupon a bayonet catch locks it into position. To close the lens the catch is released by giving the lens tube a slight turn to the left.

The lens is fitted with a Compur shutter speeded to 1/300 sec. Focussing by rotating the front cell of the lens is from infinity to 3½ feet.

To load the camera the bottom plate is unlocked and taken off. The take-up spool is removed from the camera and the film inserted into a slot. The take-up spool and the cassette are placed in the spool chambers, the film between them being slid into the space between the picture gate and the pressure plate. The film engages in a sprocket wheel in the usual way. A direct vision-finder and an exposure counter are provided.



Edinex 24 x 36 mm. camera with Schneider Radionar lens

EDITING SUB-STANDARD FILMS

Gordon S. Malthouse

Editor of 'Amateur Cine World'

Skilful editing cannot necessarily make a bad film into a good one, but it cannot do other than enormously improve it. This branch of film craft is probably the most important, and certainly one of the most fascinating aspects of movie-making, and in the following article an expert illustrates its correct use with clear examples

See *Cinematography : (3) Advanced Methods ; Continuity*

IT is in editing his films that the amateur cinematographer embarks on the creative stage. The actual filming might have been more or less mechanical, a shooting of scenes and objects as the occasion offered. In editing he welds together the different shots to tell a story or give an impression.

It is not an operation to be reserved only for the film play, the documentary film and other "pictures with a purpose." It is one that every type of film should undergo, whether it be an unpretentious holiday record or a story film on a large scale. If the amateur does not care to be bothered with it, let him at least trim the beginnings and endings of his shots, taking off two frames here, and a frame there. He will be surprised how this simple process will vitalize them.

He must, however, be on his guard against being too clever in trying his prentice hand at impressionistic styles before he properly understands the fundamentals. The audience should never be aware of the "mechanics" of a play ; they must not be allowed to realize that they are seeing a series of separate film strips. If one becomes too preoccupied with the editing, there is the danger that the purpose of the film will be obscured in recondite tricks. The first essential is clarity of expression. If you succeed in conveying to the audience just what you had in mind when you took the film you will have made a successful job of the editing. Let the pictures tell the story.

Same Pictures — Different Story. Merely by the alteration of their order and length, a different complexion can be put upon the same picture, which can suggest emotions or feelings not inherent in the shots themselves. If a person is shown laughing in one shot and this shot is joined on to one of a baby gurgling happily, the audience will assume that the person is laughing at the baby. If a liner is seen in medium long shot and we then cut to a scene on a liner, it will be assumed that the liner seen in the second shot is the one featured in the first, though they might be different vessels and months separated the taking of the shots of them. We can take the shot of the laughing man and join it on to one of a dog lying dead by the roadside. By so doing we alter the man's character completely, showing him to be callous. Yet in actual fact he might have been laughing not at live baby or dead dog but at a private joke of his own.

Now consider the following episode :

1. C.U. Girl's horror-stricken face.

Cut to

2. M.C.U. Man advancing menacingly.

Cut to

3. M.C.U. He seizes her and they struggle

Cut to

4. M.C.U. Girl releases herself from his grasp and darts to drawer, which she opens and—
Cut on action—
5. C.U. Takes out revolver, and as—
Cut—
6. M.C.U. He makes to knock it out of her hand—
Cut—
7. C.U. She fires and—
Cut—
8. M.C.U. He crumples up and—
Cut—
9. M.C.U. Lies prone on the floor.
Cut—
10. C.U. She stares at—
Cut—
11. M.C.U. Him as he lies there (shot 9 repeated) and then rushes—
Cut—
12. To the window and flings it open, calling out to—
Cut—
13. M.S. A policeman who is seen below. He—
Cut—
14. C.U. Looks up quickly and—
Cut—
15. M.S. Runs forward.

If after shot 7 we arrange the order of the shots as follows: 14, 12, 15, 1, it will seem that the policeman has heard the shot and that the girl's terror is due not so much to the fact that she has killed the man but that the policeman is approaching. Yet we have not altered the shots themselves in any way. It is their order that produces this effect.

The amateur must dismiss from his mind any feeling that he must be scrupulously truthful in the presentation of his shots. His only concern should be to show them to the best advantage, and, if by the manipulation of the film strips he departs from exactitude, that is of no consequence, provided that the falsification of the chronological order is justified by the results. It does not matter that the shot of the pier was taken on Thursday and the sequence of father fishing from it on Saturday. The two have affinities and should therefore be joined. It would be wrong to separate them by the intervening shots which might have no relation to them.

Order and Tempo. In arranging the order of the shots one must also pay due regard to the nature of each; *e.g.* we have taken a number of shots of people and traffic in a busy street. If they are joined together so that traffic and pedestrians all move in the same direction, the effect will be that of a procession. The audience will assume they are going somewhere for some purpose, and will be annoyed if subsequent shots reveal that this is not the case.

At the same time, if one *were* filming a procession, a string of shots from the same viewpoint would be dull and uninspiring. To vitalize them one could join a shot taken obliquely from the left to one taken obliquely from the right (the direction, of course, being preserved) and follow them with a shot of the procession advancing right at the cameraman. If it were a church procession the shots would be comparatively long in length to accord with the dignity of the subject. Were it a procession of unemployed in an ugly mood we should cut them short to bring out the feeling of excitement. Supposing, however, that the path of the men was barred by a row of police. The first shots showing the men's advance would be quickly cut; then we should cut abruptly to a long shot of the police, immobile, waiting. The effect of this shot of longer footage than the preceding ones would be to convey to the audience the reaction of the marchers; the abrupt change of tempo suggesting this.

The repetition of a shot can also suggest a mood not inherent in the strip itself. For instance, a shot of a dog sitting by a gate is in itself neither pathetic nor amusing. Now assume that a small boy tells his dog to be good and wait until he comes back from a little jaunt with his pals. They make an afternoon of it. A quarter of the way through the film, cut in the shot of the dog. The audience will assume that all the time the boys have been playing the dog has been patiently waiting. Repeat the shot at carefully timed intervals, and the more susceptible of the ladies in the audience will be almost in tears at the apparent patient devotion of the dog, and increasingly indignant with its owner.

Similarly they will find amusement in a shot that, considered as an entity, entirely lacks it. Supposing the family is on holiday and that father arranges to run down in the car to join them for a few days. Before he starts out he overhauls the engine, and one takes a shot of him peering into its bowels, the bonnet of the car raised.

If this shot is cut in at certain intervals throughout the film it will appear that father was unable to start at all, and each succeeding shot of him investigating the engine will cause increasing amusement.

Associative Cutting. The amateur is usually most reluctant to cut anything that he has taken. He would have fewer

misgivings if he would bear in mind that, provided they are correctly exposed, every shot unsuitable for the film in hand can almost certainly be found a place in other productions; *e.g.* suppose he has a shot of two ducks waddling down a lane but cannot find a place for it in the film in hand. In another production he has a shot of two old ladies ambling along the promenade. If he cuts in the shot of the ducks after that of the old ladies the one will act as a commentary on the other. This leads us to a consideration of associative cutting, which can be classified as (*a*) mental association and (*b*) visual association.

(*a*) Mental Association. The shot of the ducks can be regarded as mental association cutting; it gives point to the preceding shot. The novelist would write: "The old ladies ambled along, for all the world like a couple of ducks."

It is the business of the film-maker to express the simile pictorially. If he is always concerned with objective fact his film will lack cumulative interest. He should not be content to show an incident baldly and without comment, but should record by means of revealing shots how that incident affects the protagonists of his film.

(*b*) Visual Association. This is not a commentary, but a linking of sequences. A shot is matched with another by means of a pattern which is common to both; *e.g.* a man goes by car to a casino. Cut from a close-up of a car-wheel revolving to a close-up of a roulette-wheel spinning. It will be noted that, in order to make the similarity the more readily apparent, close shots are in most cases preferable. An example of this is given in page 332.

We have already referred to the fact that it is unnecessary to adhere strictly to the chronological order of the shots taken. There are cases in which not only is it unnecessary, but impossible; *e.g.* when several people are doing the same thing all at once, as in the start of a race. One could show the start in long shot, and thus show the actions in the one frame, but if we do this the action will be remote and unexciting. We must therefore break up the sequence into its component parts and show each part for so brief a period of time that simultaneous action is suggested. Thus, at the same time as the starter raises his gun the runners will be getting into position; one will be toeing the line, another bracing himself for the spring forward, a third will be making a hole in the cinder track for a quick get-off. If, however, each of the shots of these actions is so short that they are little more than flashes, the audience will accept the suggestion that they are simultaneous. Each need be no more than, say, six inches in length. There is, therefore, no need to show simultaneous action in one embracing long shot.

The minimum lengths for 9.5-mm. and 16-mm. can be regarded as: 30 inches for a medium shot, 20 inches for a medium close-up, and 10 inches for a close-up, with 8-mm. in proportion, although, of course, this can only be accepted as a very rough guide. The nature of the shot determines the footage.

Editing Methods. The amateur may be tempted to edit his film as soon as he receives it back from the processing station. He must guard against precipitancy, and before cutting should screen it not once but a dozen times, continually stopping the projector to familiarize himself with certain shots until he has a complete mental picture of them all.

Each editor has his own methods of documenting his shots for easy reference. Probably the simplest, although it may take some considerable time to do, is to list all of the shots on each spool, numbering them from one upwards. The spool is then cut up into its several shots and each is labelled with a small piece of adhesive tape bearing its number on the list. These are clipped with paper fasteners, or put into racks or boxes.

The precise method of filing the shots matters little; the cutter will choose the one that is most convenient to his situation. Some will refine the process by collecting all the long shots together, all the medium shots, and so on. This method is to be recommended when the film has been shot to plan and can be assembled with the aid of a script; but if it has been shot haphazardly and is to be assembled more or less in chronological order it will not be found so convenient. But remember that the order in which the shots were taken is of little account. Good editing is the assembly of the shots in such a way that they portray a cameo of intelligent incident or action, when individually they may be more or less meaningless.

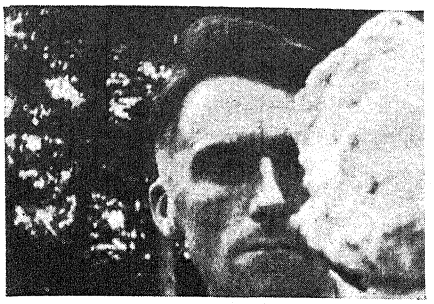
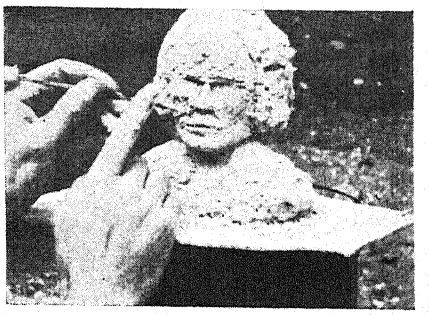


Fig. 1. Opening the sequence. The audience is intrigued by someone making passes at an ill-defined shape, which proves to be—



—a bust (**Fig. 2**). The camera goes some distance back and then—



—takes in a point on the right of the bust (**Fig. 3**). This reveals that the latter is intended to portray Beethoven



Fig. 4. The field of vision is then widened, leading us to—

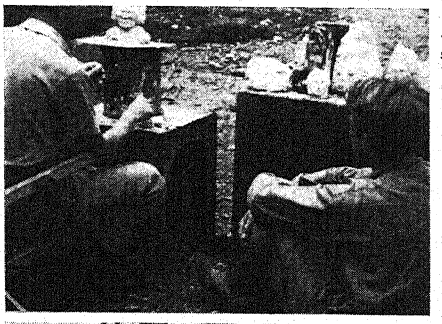


Fig. 5, in which we see both the sculptor at work and some of his handiwork on the right of the picture

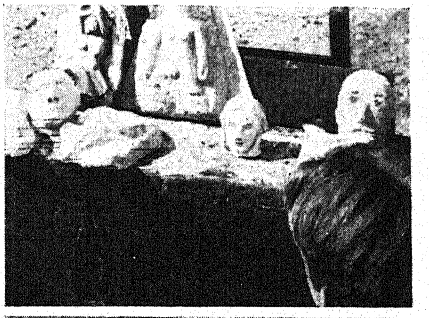


Fig. 6. The camera now concentrates on the pieces of modelling on the right



Fig. 7. The youth takes down one of them and—



—examines it (**Fig. 8**). The camera moves, and next—



—the audience sees it as he sees it (**Fig. 9**). They are then shown—



—the various pieces on the bench in a slow "pan" (**Fig. 10**)

EDITING A FILM

ELECTRICITY AND THE PHOTOGRAPHER

Bernard Alfieri, Jr.

In arranging the dark-room and studio much inconvenience and inefficiency, and even danger, can be avoided by intelligent planning of the electrical equipment. This article covers all the essential points of the subject, and provides information on wiring, local regulations, fittings, and wiring lay-outs for both amateur and professional purposes

FORETHOUGHT in planning electrical equipment in the dark-room, or small studio, may save a lot of trouble and expense at a later date. A beginner selecting a small room as a dark-room may have a single 5-amp. point in a central position and feel that this is sufficient; then, as the work progresses, an extra lead is required for additional fittings, until it becomes quite evident that something must be done.

Wiring a Small Dark-Room. Several points are required, even in a small dark-room, if the electrical equipment is to be efficient. Also, convenient distribution cannot be undertaken with any odd lengths of flex. The question of overloading is a very serious one, and even if extensive apparatus is not required at the outset, many gadgets will probably be added later.

Let us consider exactly what may be required, and the approximate amperage:

Whitelight	say	60 W.
Safelight	„	20 W.
Enlarger	„	150 W.
Printing-box	„	150 W.
Print dryer	„	500 W.
Immersion heater	„	500 W.
Fan	„	20 W.
Room heater		500–1,000 W.

Provision can also be made for extra gadgets, such as a film tank agitator, a film dryer, and extra safelights. The total is not a very heavy one, even if all the points are used at once, but there is too much for an ordinary lighting circuit.

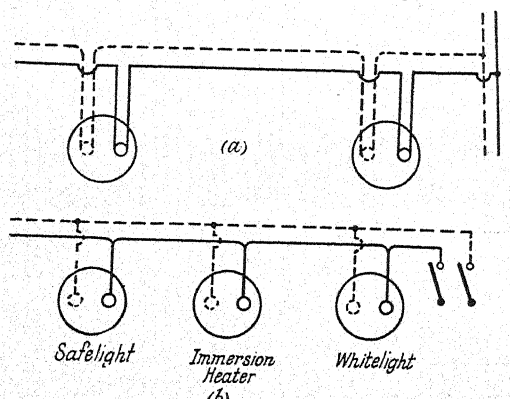


Fig. 1. Wiring arrangement with main switch near door and series of plug sockets (*b*) for safelight, immersion heater and white light. Spare points (*a*) are for special requirements

The wattage can be determined by multiplying the voltage by the amperage, which conversely will allow us to ascertain the necessary amperage from known wattage. If, for simplicity, we assume the supply voltage to be 200 volts, then for every kilowatt (1,000 watts) we shall be using 5 amps. —that is, 200 volts multiplied by 5 amps. equals 1,000 watts. It is obvious that in a small dark-room we may not require more than from 10 to 15 amps., but if a plug were fitted to provide such a supply, it would be inconvenient to distribute it to the various fittings which are located in different parts of the room.

Wiring Regulations. Apart from the I.E.E. regulations for electrical equipment of buildings, which are supplementary to the Home Office Regulations, there may be local arrangements with which to conform, and the whole matter has been simplified by a definite rule from the 1st of January, 1937, which provides for the compulsory use of 3-pin plugs, and steel conduits.

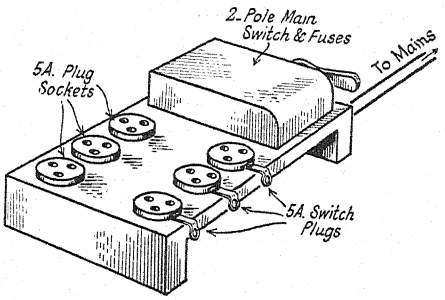
This means that all permanent installation wiring must be encased in a steel conduit, efficiently earthed, which is, after all, but a safeguard for the user and would be wise policy in any case, particularly in a dark-room where wet hands may become a danger.

Bearing such regulations in mind, the easiest way to deal with the room would be to have at least a 15-amp. point provided, the sub-circuits being looped within steel conduit round the walls, with a series of plugs or switch-plugs from which very short flex (or, better, tough rubber) connexions can be made to the various apparatus. In this way an efficient "earth" can be obtained, with a minimum of flex to each fitting.

Fig. 1 shows a typical lay-out, which, of course, must be planned to suit particular

requirements. It is wired on the looping-in principle, and in some districts the local supply authorities may not approve this form of wiring. Inquiries should be made. It should be also remembered that any alterations or extensions to an existing installation must usually be notified to the supply authorities. In this plan, a main switch (2-pole) has been provided near the door, which, to save any chance of blowing the household fuses, includes separate fuses.

From this point a steel conduit runs round the room connecting a series of 3-pin switch-plugs, or plug sockets, allowing two spare points for special requirements.



SIMPLE PANEL. Fig. 2. Sketch of distribution panel with 2-pole switch, fuses, and six 5-amp. switch-plugs of the 3-pin type. The panel is portable

The initial cost of such an installation is comparatively small, and the convenience is obvious, while apart from separate switches for each piece of apparatus, the main switch at the door acts as a master-switch, to guard against leaving any sub-circuit running.

Portable Lighting and Small Studios. Lighting arrangements for home portraiture may be defined within the term portable, inasmuch as few amateurs are prepared to devote a special room to the purpose, or have extensive and possibly unsightly wiring arrangements in the home.

Fortunately, modern equipment will provide a great deal of light for a small wattage. Four small photoflood bulbs can be run for short periods from a 5-amp. lighting circuit, and where the load can be divided between two supply points, or a heating plug is provided, ample current is available. On the other hand, great care should be taken not to overload, particularly during the winter months, where some form of electrical heating may be required in the room.

Playing for safety is a wise game with electrical equipment, and all lighting apparatus should be earthed. Assuming that a spare 15-amp. heating plug is already available, a convenient distribution panel can be constructed as shown in Fig. 2. As a portable fitting the panel consists of a base on which a main 2-pole switch and fuses have been fixed, from which connexions are made to six 5-amp. switch-plugs as shown. They should all be of the 3-pin type, the earth connexions being made to the case of the main switch, which is earthed through the cable (not flex) plugged in to the supply point.

Where small portable lamps are used on the sub-circuits, the metal part of the lamp is connected to the earth wire, using light 3-wire tough rubber cable in preference to flex.

General lighting is often provided by a battery of ordinary household lamps. Ten 100-w. lamps arranged in a suitable trough can be run for short periods with safety from one 5-amp. point, but as a precaution it is safer to divide such a load between two points, or if the total load is well within the 15 amps., substitute one of the sub-circuit switch-plugs for a heavier type. When using lamps of the over-loaded type, such as photoflood bulbs, the life is short, and from every point of view it is desirable to reduce the maximum burning time to the minimum, for which purpose a series-parallel switch is a great convenience. A. P. Lundberg & Sons, Ltd., market a switch of this pattern, which will provide for dim, full, and off positions. The wiring arrangements are shown in Fig. 3, and the switch is used with a pair of lamps of equal capacity. In the " dim " position, the current passes from one lamp through the second before completing the circuit, each lamp acting as a resistance to the other, both burning at a greatly reduced strength, which is quite strong enough for preliminary arrangements, the full strength only being switched on during the actual exposure.

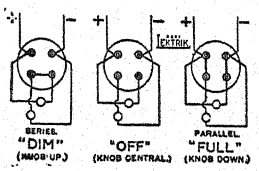


Fig. 3. Wiring arrangement of series-parallel switch providing dim, full, and off positions

Particularly with portable lighting equipment, a distribution panel using a series-parallel switch is a great convenience. This can form part of a carrying case for portable lamps, or may be constructed as a separate unit as already described. A simple panel of

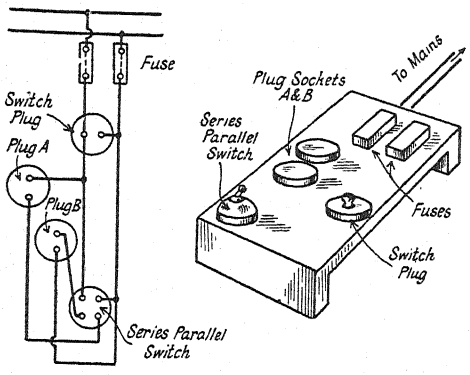


Fig. 4. Panel for connecting three photoflood lamps to 5-amp. household lighting point. Wiring diagram is shown on the left

this type is shown in Fig. 4, intended for use with three photoflood lamps, supplied from a 5-amp. household lighting point. It consists of two fuses, a series-parallel switch with a pair of plugs, and an additional switch-plug, the wiring for which is also shown in Fig. 4.

Although it is impossible to avoid cables trailing across the floor when using portable lighting, a great deal can be done to avoid the sort of muddle which causes people to trip over, and is difficult to control. To tread on flex spells danger: to hide it under a carpet is not only against regulations, but is exceptionally foolish, and to use flex at all for this purpose is unnecessary. Tough rubber cable, even for 5-amp. sub-circuits, obviously forms the best and safest portable connexions, and the simple rules governing the use of electrical fittings should be scrupulously followed. Do not let a live cable terminate in a plug or lamp adapter where the contacts can be touched. When this has been mated with the corresponding fitting it may be safe, but it is contrary to general electrical practice, and it might be very dangerous if left about with the current switched on. Long cables may be a convenience inasmuch as they allow individual lamps to be taken to the extremes of the room, but every inch of loose cable is something more to get in the way; for which reason some form of winder should be used to avoid unnecessary cable, and the cable which is actually in use should be visible, and not tucked away behind furniture or household fittings.

Planning a Small Professional Studio. When planning the installation of electricity in any small studio, ample supply should be arranged for extending the equipment. Most portrait studios will not require nearly such heavy cables as studios intended for general commercial work, and particularly in the latter case ample margin should be provided. There is very little difference in the cost of installing heavier cable in the first place, where to provide an additional supply at a later date might involve alterations and considerable expense.

In a small portrait studio there may be a very low current consumption, the general light being obtained from three or four 500-w. lamps, used in conjunction with a couple of 500-w. stand lamps, a 500-w. spotlight, and probably a heating point covered by 15 amps. This amounts to under 35 amps., and at 200 volts would be safely covered by 7 kw. If the wiring provided for 10 kw., it would allow for future extensions and leave a good margin. The remarks applied to methods of distribution in a dark-room may be used with advantage in a small studio. There is no excuse for cables trailing over the floor, the lamps may be operated from points provided in convenient positions round the room, and as far as possible the cables should be hung overhead. A variable resistance for dimming individual lamps will be found of great utility, while a master switch near the door is to be recommended.

The small commercial studio presents much more exacting requirements. For most work an electrical output within that of the portrait studio would be quite sufficient, but the occasional job, where a great deal of light is required, must be provided for. However much light is available, there will always be moments when, for an isolated job, more light is required, and the remarks regarding plenty of margin are doubly applicable.

If the studio is to be used for general work, provision should be made for an overhead unit, a trough of lamps, at least two stand projectors of about 2 kw. each, and a couple of spotlights, as well as portable reflector units of 500 w. each, making a total of not less than 10 kw., apart from the question of electrical heating.

Bearing in mind that there is very little difference in the cost of the initial installation, it would be well worth while providing for a consumption of 20 kw., the actual lighting apparatus being installed as required,

in the knowledge that no alterations will be necessary during any reasonable expansion. The detail lay-out and arrangement of control panel must be influenced by individual requirements, but as far as possible local distribution should be undertaken from permanent points, the position for which has been determined from a practical standpoint. The cable feeding such sub-circuits being part of the general installation cannot come under the heading of portable, and must conform to the appropriate regulations. It should be enclosed in a steel conduit, which should be fixed according to the I.E.E. regulation No. 408, of which the following extracts may be of service :

The conduits of each circuit are erected complete before the cables are drawn in.

The conduits are prevented by spacing, insulation, or other means, from coming into contact, under any conditions of service, with gas pipes or water pipes, and if liable to mechanical damage are adequately protected.

No elbows or tees, unless of the inspection type, are used, except at the ends of conduit immediately behind fittings or accessories ; and no bend has a radius smaller than 2½ times the outside diameter of the conduit.

The conduits are mechanically and electrically continuous across all joints therein and are earthed.

From the various points provided by the permanent installation, the connexion to apparatus is obviously of a portable nature, and should be made through tough rubber cable of ample carrying capacity, all lamps and apparatus being efficiently earthed.

Where lamps of the mercury discharge type are to be used, such as the Osira Studio Floodlight, the installation of a choke and condenser becomes necessary, and are provided as part of the equipment by the manufacturers. Such subsidiary apparatus may be suitably fixed to the wall, and a lead taken from the choke direct to the lighting outfit.

When employing batteries of lamps, the value of independent switching soon becomes obvious. It is often a good plan to arrange a central switch panel in the most convenient place on which sets of switches have been identified by colours ; for example, an overhead unit of say 12 lamps wired with three switches controlling 4, 8, or 12 lamps, the switches being arranged together with a red plate, while a similar set of switches identified by green might perform the same function on a side battery used on the floor. Single switches can be used for controlling single lamps, the stands of which are coupled by colour bands to correspond with their switches. Where one operator is always working the same apparatus, familiarity with the switches soon becomes automatic, but in general use, particularly with changing of points, such identification is useful.

A series-parallel switch may be installed to control batteries of lamps divided into two circuits, which offers the following advantages over two separate switches. First, there is only one switch to deal with ; secondly, the spread of light remains constant during " dim " and " full " positions, which would not be the case unless the lamps were arranged in such a position that alternative bulbs could be controlled, and thirdly, all the lamps receive equal wear.

Practical Hints and Tips. Electrical apparatus used in amateur photography is confined mainly to that pertaining to lighting in some form or another. In the amateur studio, for instance, temporary lights have to be " rigged up " and dismantled, so that an elementary knowledge of practical electric wiring is essential.

Fuses. Before adding any electrical apparatus to an existing circuit, the fuses should be examined to see that they are heavy enough to carry the extra current. This applies not only to the fuses controlling this particular circuit, but to the main fuses also.

The maximum safe working current of the usual size of household fuse wires is given in the following tables :

COPPER WIRES (usually " tinned ")

Diameter of wire in inches	Equivalent S.W.G. size	Fusing current in amps.	Safe working current in amps.
0.036	20	62	31
0·028	22	41	21
0·022	24	30	15
0·018	26	22	11
0·0148	28	17	8·6
0·0124	30	13·5	6·8
0·0108	32	11·0	5·5
0·0092	34	8·6	4·3
LEAD-TIN ALLOY WIRES			
0·064	16	16	11·0
0·048	18	10	7.0
0·036	20	7	4·8
0·028	22	5	3·3
0·022	24	3·5	2·3

Now suppose that lamps, or other apparatus, of a total of 1,000 watts are being installed, and the supply voltage is 250.

1,000 divided by 250 = 4 amps. A number 20 lead-tin or number 34 copper wire is therefore suitable. On a 100-volt supply the amps. would be 10, and a number 26 copper fuse wire would be required.

It is advisable to use the lead-tin fuse wire for the smaller currents, and the copper wire for those above, say, 8 amps.

Flexible Insulated Wires. When using high wattage lamps it should be noted that the ordinary thin " flex " (*i.e.* the thin cord used for table lamps, etc.) will probably be too light to carry the current. Good substantial " flex " such as is supplied for electric irons, or small radiators, should be used. Alternatively, several " flexibles " can be connected into the one plug. If any doubt is experienced, an electrician should be consulted.

For total wattages over 200 or 300, the " flex " should be connected to a wall plug. If connected to a lampholder adapter, the lamp-holder springs may lose their temper and cease to function.

Finally, all flexible wires must be in good condition, both externally and as regards the condition of the rubber insulation. Otherwise, short-circuits, shocks, or fire may result.

Fittings. All portable fittings such as switches, lampholders, etc., should be of the " all-insulated " type, to prevent danger of shock. *Any switches in the dark-room also should definitely be of this type.*

An exception to this will probably be the enlarger. Most of the newer enlargers are made of metal, in direct electrical connexion with the metal lampholder. In this case a triple flex should, if possible, connect to a " three-pin " plug, the third wire being an " earth " wire. It is connected to the metal case of the enlarger and to the " earth " pin of the plug.

The switch for the enlarger (or, indeed, any apparatus) should be connected in the " phase " or " live " wire, to ensure that the enlarger is " dead " when the switch is " off." An electrician will decide whether this is so in a few minutes.

Electrical fittings, or apparatus of any kind, should never be touched with wet or damp hands. This is a real danger in the dark-room, where it is so easy to switch on or off the light with a finger wet from immersion in a solution or washing bath. *This point cannot be too strongly emphasized.*

It is also safer not to touch a metal switch, or other apparatus, when standing on a stone floor, or when touching metal pipes, etc.

Connecting Up. Several lampholders can be wired thus. The lampholders are then said to be wired in " parallel " (Fig. 5).

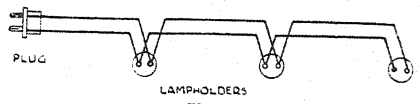
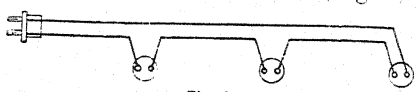
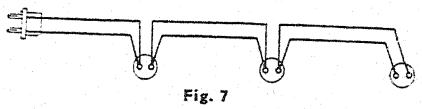


Fig. 5

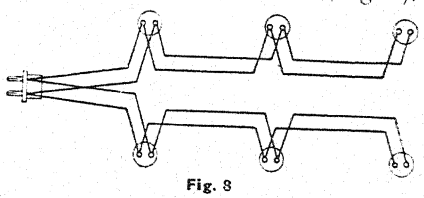
" Series " wiring is shown thus, but this is seldom used by the amateur (Fig. 6).


Fig. 6

Another connexion which gives a " dead short-circuit " must be avoided at all costs (Fig. 7).


Fig. 7

Wiring several banks of lamps to the one plug can be safely effected thus (Fig. 8).


Fig. 8

Switches can be inserted as follows, firstly, to control all the lamps (Fig. 9).

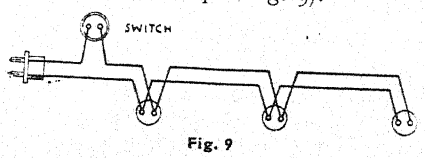


Fig. 9

Or one switch for each lamp (Fig. 10).

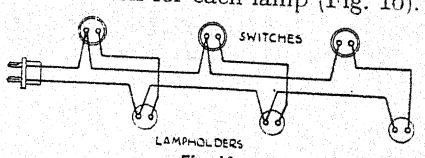


Fig. 10

Take care to see that the insulation at the end of each wire is taken right up to (or into) the porcelain or bakelite of the lampholder, switch, etc. Bare ends will cause short-circuits.

EMULSIONS: (1) TECHNICAL PRINCIPLES & PROCESSES

H. Baines, D.Sc. (Lond.), F.I.C., F.R.P.S.
Vice-President, Royal Photographic Society

To acquire a complete knowledge of photography it is necessary to be conversant with the scientific principles governing the manufacture of emulsions which form the physical basis of all types of photograph. This article, written by an eminent authority, covers the subject comprehensively and explains not only the purpose and action of their constituents, but how emulsions are made and applied to plates, films and paper

A PHOTOGRAPHIC material consists of a light-sensitive layer coated on to a support, usually glass, film or paper. The term "photographic emulsion" is applied to the light-sensitive layer, either in the solid form on the support, or in the liquid form before application thereto. The term "emulsion" is something of a misnomer since it is conventional to reserve it for a dispersion of a liquid in a non-miscible liquid phase (*e.g.* oil in water), whereas a photographic emulsion consists of a dispersion of a solid in a liquid phase. Although the term "photographic suspension" would be a more accurate description, yet the prevalent convention is in such universal use that attempts at correction would lead to too much confusion.

Photographic emulsions have as the essential constituent a salt of silver. If a piece of metallic silver be immersed in warm dilute nitric acid it will dissolve with evolution of gases, and will leave finally a clear colourless solution which contains the silver in the form of a salt—silver nitrate. If the solution be evaporated, the silver nitrate will appear in the form of clear colourless crystals. Like most salts of silver, silver nitrate is somewhat unstable, and on exposure to light it decomposes to give finely divided silver which causes the crystals to darken in colour.

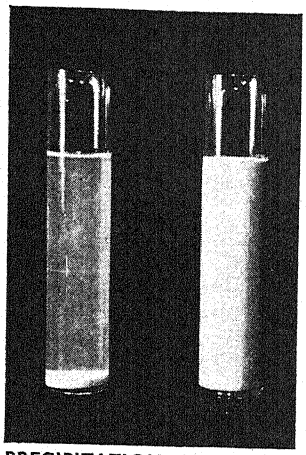
Light-Sensitive Silver Salts. A crude form of photographic material could be made by soaking paper in silver nitrate solution and drying; this was, in fact, used by Wedgwood in 1802 for producing silhouettes of leaves and other small objects. Later, however, other salts of silver were tested as the basis of a light-sensitive material, and silver chloride, bromide, and iodide were found to be the most effective. These salts may be produced by direct combination of metallic silver with the element chlorine, bromine or iodine respectively. These three elements are very similar and closely related in a chemical sense and are grouped together under the general name "halogen," the salts (chloride, etc.) being termed "halides." The halides of silver are all insoluble in water; the chloride is white, the bromide pale yellow, and the iodide lemon yellow.

The usual method of preparation is by interaction between solutions of silver nitrate and an alkali (potassium, sodium, ammonium, etc.) halide. If the alkali halide be potassium bromide, for example, the reaction is expressed in chemical symbols according to the equation:

$$\underset{\text{Silver Nitrate}}{AgNO_3} + \underset{\text{Potassium Bromide}}{KBr} = \underset{\text{Silver Bromide}}{AgBr} + \underset{\text{Potassium Nitrate}}{KNO_3}$$

Of the four compounds considered in the above equation, one only, silver bromide, is insoluble in water, so that one of the interesting features of the reaction is the formation of an insoluble solid (in the form of an infinite number of unresolvable particles) by mixing two clear solutions. The throwing out of solution of a solid in this way is termed "precipitation" and the solid itself is the "precipitate." When precipitation of silver halide is carried out in plain aqueous solution, the uniform milky liquid which is first formed rapidly changes in appearance. The precipitate "coagulates," or clots together, and settles to the bottom of the vessel in the form of a heavy curd, as shown in Fig. 1, page 628.

Precipitation is the general method of preparing the silver halides of photographic emulsions, coagulation being effectively prevented by the presence of some viscous colloidal constituent such as collodion or gelatine (Fig. 1). When collodion is used as the dispersion medium, the reacting salts must be dissolved in organic solvents, as collodion



PRECIPITATION. Fig. 1. Showing how silver halide coagulates in plain aqueous solution, and (right) how presence of colloidal constituent acts as dispersion medium

itself is insoluble in water. Collodion emulsions were first prepared by Scott Archer in 1850, and were in general use until gelatine, introduced by Dr. Maddox in 1871, displaced collodion as the dispersion medium. Not only does gelatine efficiently prevent coagulation and settling of the silver halide, but, unlike collodion, it imparts a high degree of sensitivity and, moreover, its viscosity and ability to set as a jelly are of considerable advantage in emulsion manufacture and coating. It is so much superior to collodion that apart from certain print-out materials and plates used in the printing trade, collodion has been entirely superseded.

Silver Chloride Emulsions. (*a*) Print-Out Materials. Of the three halides of silver, silver chloride most easily darkens on exposure to light, and hence is used as the basis of print-out and self-toning papers. The darkening is due to the decomposition of silver chloride into silver and chlorine. In the dark, however, silver and chlorine recombine to give silver chloride. If silver chloride crystals be exposed to light in an open vessel, the gaseous chlorine will diffuse into the atmosphere and complete recombination in the dark could not take place. When silver chloride crystals are bound up in gelatine, diffusion of the chlorine is virtually impossible. Some of the liberated chlorine reacts with gelatine, but the latter is soon saturated, so that unless the chlorine can be rapidly removed from the sphere of activity only a slight darkening can take place.

The desideratum may be effected by having present a " chlorine acceptor," which usually takes the form of a more soluble salt of silver such as silver citrate. This immediately combines with the liberated chlorine to re-form silver chloride, the net result being the formation of metallic silver at the expense of the silver citrate. As the medium plays little or no part in the print-out mechanism, the silver salts of print-out materials are bound in either gelatine or collodion.

(*b*) Self-Toning Papers. The grains of silver chloride emulsions are usually much finer than those of other types of emulsion, and the silver particles formed by printing out are finer still. In an extremely fine state of subdivision materials exhibit colour phenomena very different from those of the massive state, the actual colour varying with particle size. The silver obtained by printing out is, after fixation, of an unpleasant sandy colour and is usually modified by immersion in a dilute solution of a gold salt, which deposits metallic gold on the silver of the image. This process is known as " toning," and " self-toning " papers may be prepared by including a small quantity of a gold salt in the silver chloride-citrate emulsion.

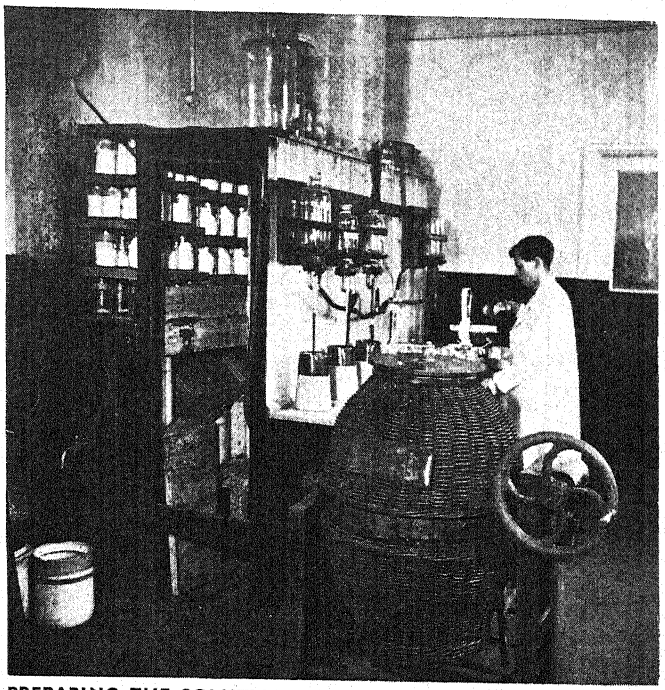
(*c*) Gaslight Papers and Lantern Plates. Silver chloride-gelatine emulsions make excellent development materials of the very slow, very fine-grain type. With all development materials there is no need to include a " halogen acceptor " other than gelatine, which is itself an excellent acceptor for the minute quantities of halogen, liberated in the formation of the latent image. Silver chloride-gelatine emulsions are used mainly in the manufacture of gaslight papers and lantern slides. On development they give a very fine-grained image of extreme blackness, but by restrained development this may be modified to warm black tones.

Chloro-Bromide Emulsions. Emulsions prepared by co-precipitating a mixture of silver bromide and chloride in gelatine are used for " chloro-bromide " development papers. They are considerably more rapid than gaslight papers and have the advantage over bromide papers of finer grain, with the ability to produce by development a wide range of warm tones varying from a brick red to a warm black (*see* Chloro-Bromide Printing).

Iodo-Bromide Emulsions. This most important class of photographic emulsions consists of silver bromide with a small proportion of silver iodide (usually between 2 per cent. and 6 per cent.), and is used for practically all negative emulsions and the faster positive emulsions such as those for

bromide papers, cine positive film, etc. Its manufacture is generally more complex than that of chloride and chlorobromide emulsions and may be considered in four stages, viz. emulsification, ripening, washing, and digestion.

Emulsification. The first stage of emulsion manufacture is known as emulsification and consists in precipitating the mixture of silver iodide and bromide in the presence of gelatine. Conditions at emulsification may have a profound effect upon the subsequent photographic properties, and hence they must be controlled with extreme accuracy. The halides—usually ammonium or potassium bromide and iodide—are accurately weighed and dissolved in a measured quantity of water to which the gelatine has been added, and the whole adjusted to a specific temperature. An accurately prepared solution of silver nitrate which may contain ammonia is also adjusted to temperature and added either rapidly or slowly through a jet, or in several portions at definite intervals.



PREPARING THE SOLUTION. Fig. 2. View in department of photographic materials factory where the solutions of silver nitrate and halides are prepared. The work entails precise regulation of temperature and meticulous adjustment of concentration. The process is carried out in daylight

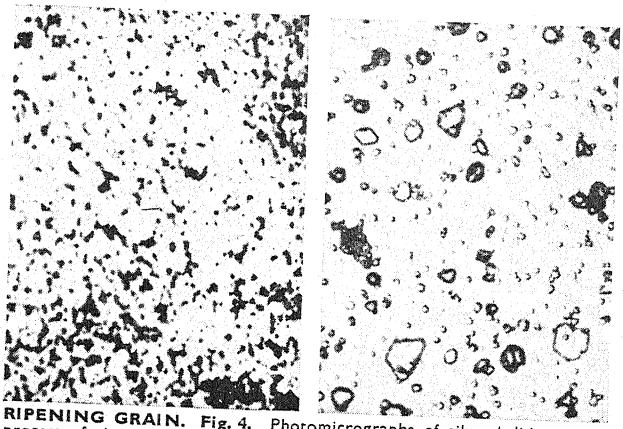
The relative proportions of silver nitrate and halides are chosen so that the latter is in excess of chemical equivalence. The conditions of concentration, temperature, method of addition, etc., vary with different emulsions, and are adjusted according to the photographic qualities desired. The solutions may be prepared in daylight ; emulsification and all subsequent operations must be carried out in an appropriate safelight. Figs. 2 and 3 show the solution preparation room and the emulsification process in a photographic factory.



EMULSIFICATION PROCESS. Fig. 3. The initial step in emulsion manufacture consists in the precipitation of the silver iodide and bromide in the presence of gelatine. Here are factory operatives carrying out this work

Photo, Courtesy of Ilford, Ltd.

Ripening. Immediately after emulsification the emulsion has an extremely fine grain, usually unresolvable by the microscope, and it is also relatively insensitive to light. By maintaining at a specific temperature, it is found that the grains increase in size and sensitivity to light. This process is known as ripening, the rate of increase in size and sensitivity of the grains depending *inter alia* on the concentration of mild solvents for silver halide such as excess alkali bromide and ammonia which may be present in the emulsion.



RIPENING GRAIN. Fig. 4. Photomicrographs of silver halide grain in process of ripening, showing the transition from an amorphous agglomeration to crystals

The mechanism is interesting. When dealing with extremely small particles it is found that solubility depends on particle size, the smaller grains of silver halide being more soluble than the larger particles. Hence the smaller grains gradually dissolve and crystallize out on the surface of the larger particles, the net result being a decrease in number of grains and an increase in average grain size with corresponding increase in sensitivity. Fig. 4 shows photomicrographs of the silver halide grain of an emulsion at various stages during ripening, and demonstrates the transition from an amorphous agglomeration of unresolvable particles to well-defined crystals.

Like emulsification conditions, the ripening conditions profoundly influence the final properties of an emulsion and hence must be controlled with scrupulous accuracy. Slower fine-grain emulsions receive little ripening, while the fastest emulsions are ripened for a considerable time in the presence of a relatively high concentration of ripening agents such as ammonia or excess alkali halide. The grain sizes of various emulsions are shown in the accompanying table.

Grain Sizes of Emulsions

Emulsion	Average grain size	
	Undeveloped	Developed
Lantern Slide ..	0·10 μ	0·15 μ
Half-tone	0·24 μ	0·45 μ
Slow ordinary ..	0·63 μ	0·80 μ
Medium speed ordinary	0·73 μ	1·10 μ
Portrait..	0·82 μ	1·30 μ
Ultra rapid	1·15 μ	1·80 μ

(μ = 0·001 cm.)

Washing. After the ripening stage it is usual to remove the excess alkali halide, ammonia, and the by-product alkali nitrate. As these compounds are all freely soluble in water, the usual method of removal is to chill the emulsion so that it sets to a stiff jell (after adding more gelatine if necessary), shred it through a perforated silver plate (Fig. 6, p. 631), and suspend the shreds or "noodles" in a canvas bag in running water until all the soluble constituents are completely washed away. The degree of washing may be checked by electrical conductivity methods, or by chemical tests.

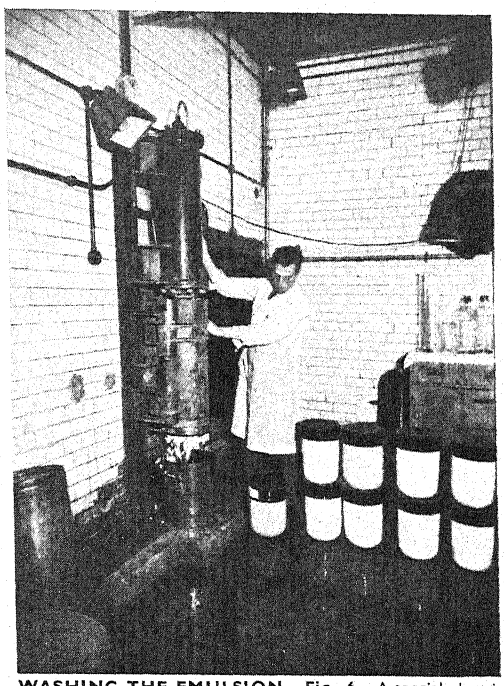
Digestion. After washing, the speed and contrast of an emulsion may generally be increased considerably by a second heat treatment, which is known as after-ripening, or digestion. Accordingly, the shreds are drained, made up to standard weight and composition by addition of the requisite quantity of water and gelatine, and maintained at a definite temperature for a predetermined time sufficient to produce the required photographic quality. If this treatment be carried to excess—that is, if the emulsion be over-digested—the grains become developable without exposure to light and the emulsion becomes "veiled" or "fogged." During digestion there is very little change in grain size, so that ripening and digestion fulfil two very different functions. Unfortunately, the mechanism of digestion is still obscure.

Final Treatment of an Emulsion. On completion of digestion the emulsion, if not immediately required for coating, is cooled and set, and stored in a refrigerated chamber. Before applying to the support it is re-melted, and certain final additions are made to facilitate coating and to modify the properties of the coated film. Addition of alcohol, for example, minimizes the formation of froth during coating; saponin reduces the surface tension and thus promotes evenness of coating and facilitates the subsequent spreading of developer; chrome alum or formalin renders the dried film less soluble in water and makes the film more suitable for tropical processing; special stabilizers impart good keeping properties; and sensitizing

dyes are added to modify the spectral sensitivity of the emulsion. Finally the emulsion is filtered and stabilized at the requisite temperature.

Colour Sensitizing. Ordinary silver iodo-bromide emulsions are insensitive to all spectral colours except blue and violet; they are, moreover, sensitive to certain rays beyond the violet end of the spectrum (ultra violet), to which the human eye is blind. A photograph therefore gives undue prominence to the bluish constituents of a picture and fails to record adequately the yellow and red components, so that coloured objects are given a very incorrect rendering in monochrome compared with their true visual brightnesses. It was found by Vogel in 1873 that the colour sensitiveness of emulsions could be modified by treatment with certain dyestuffs which stained silver bromide. Minute quantities of corallin, for example, when added to an emulsion, caused it to be sensitive not only to the blue and violet but also to green and yellow, and emulsions sensitized over this range are called " orthochromatic " or " isochromatic."

Sensitizing dyes have been the subject of very much research work of recent years, and practically all modern sensitizing dyes are members of the " cyanine " group. Many dyes are known which extend the sensitivity of silver iodo-bromide throughout the visible spectrum into the deep red, and thus produce what are known as " panchromatic " materials. By using a panchromatic material with an appropriate filter to subdue the excessive blue and ultra-violet sensitivity, it is possible to produce a monochrome rendering practically identical with the brightness of the colours as perceived by the eye.

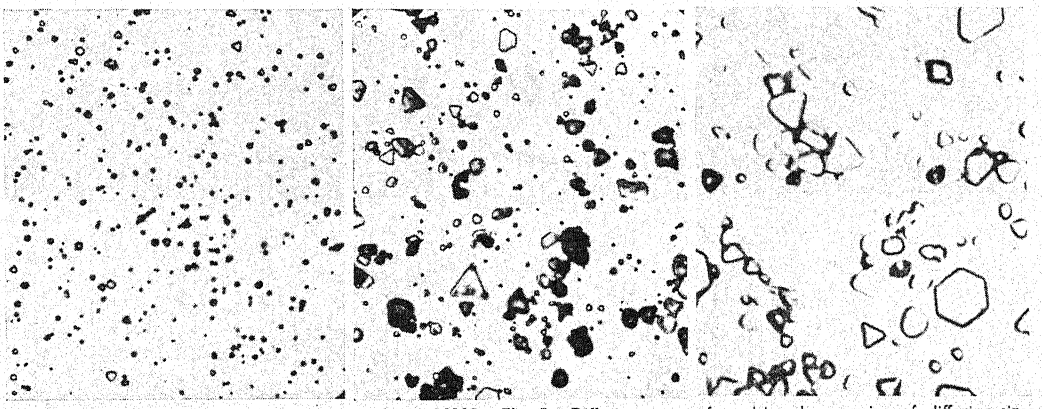


WASHING THE EMULSION. Fig. 6. A special plant is used to remove the excess alkali halide, ammonia and alkali nitrate from the emulsion. The latter is chilled, shredded and subsequently washed in running water

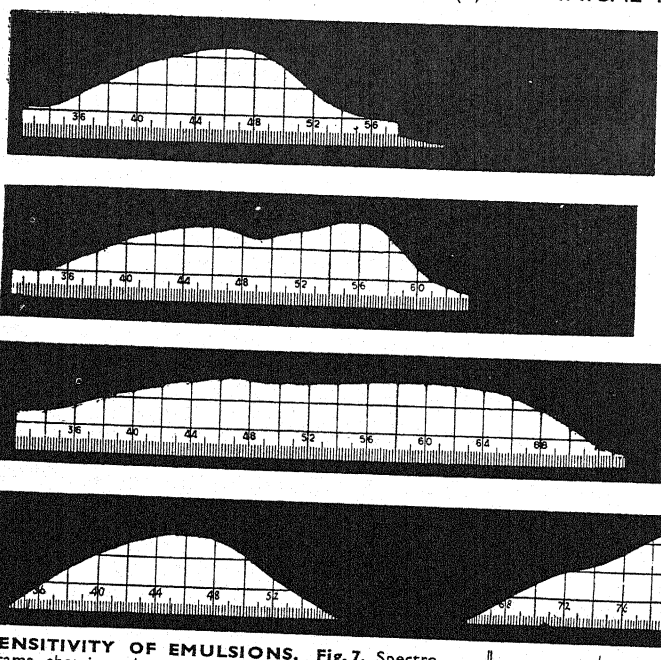
Photo, Ilford, Ltd.

In addition to orthochromatic and panchromatic dyes, certain dyes sensitize in the far infra-red and are used in the preparation of the infra-red films and plates which have found recent application in so many fields. Fig. 7 shows the sensitivity of various types of emulsion to light of different wavelengths.

Sensitizing dyes may be added at almost any stage of emulsion manufacture, but it



PHOTOMICROGRAPHS OF EMULSION GRAINS. Fig. 5. Different types of emulsion have grains of differing sizes Three examples are shown in these photomicrographs. After the emulsification process the grains are ripened in varying degrees according to the properties required



SENSITIVITY OF EMULSIONS. Fig. 7. Spectrograms showing the sensitivity of various types of emulsion to light of different wavelengths. Cyanine dyes, which are used in photographic emulsions—have been the subject of much research

is convenient from considerations of working illumination to add them immediately before coating. *(See further under* Dyes Used in Photography, p. 610.)

Pre-Treatment of the Support. The next stage in emulsion treatment is the application to the support, paper, film or glass. All these supports are specially treated before coating with emulsion. Paper is coated with a layer of finely divided barium sulphate (known as "baryta" or "blanc fixe") suspended in gelatine. This gives the paper base the requisite strength, stiffness, and smoothness, and inclusion of dye in the baryta coating modifies the colour in any desired way.

Plates are treated with a "substratum coating" of either dilute gelatine hardened with chrome alum or chrome alum solution alone, in order to obtain the necessary adhesion between emulsion and glass. The substratum coating of celluloid film consists either of an etching solution of organic solvents to give the base a "tooth" to which emulsion will adhere, or of a dilute gelatine solution in organic solvents which deposits an extremely thin gelatine layer intimately mingled at the interface with the celluloid of the base (Fig. 8). Without these substratum layers on glass or film the emulsion would readily strip off the support when dry, or frill when wet.

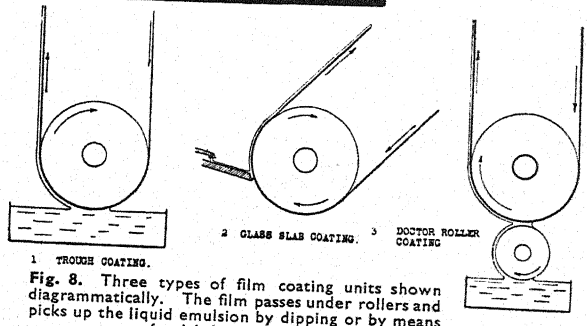
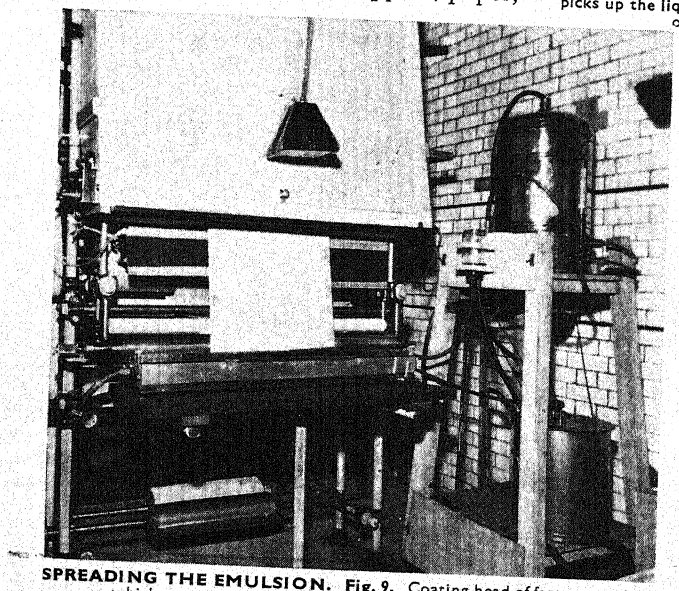
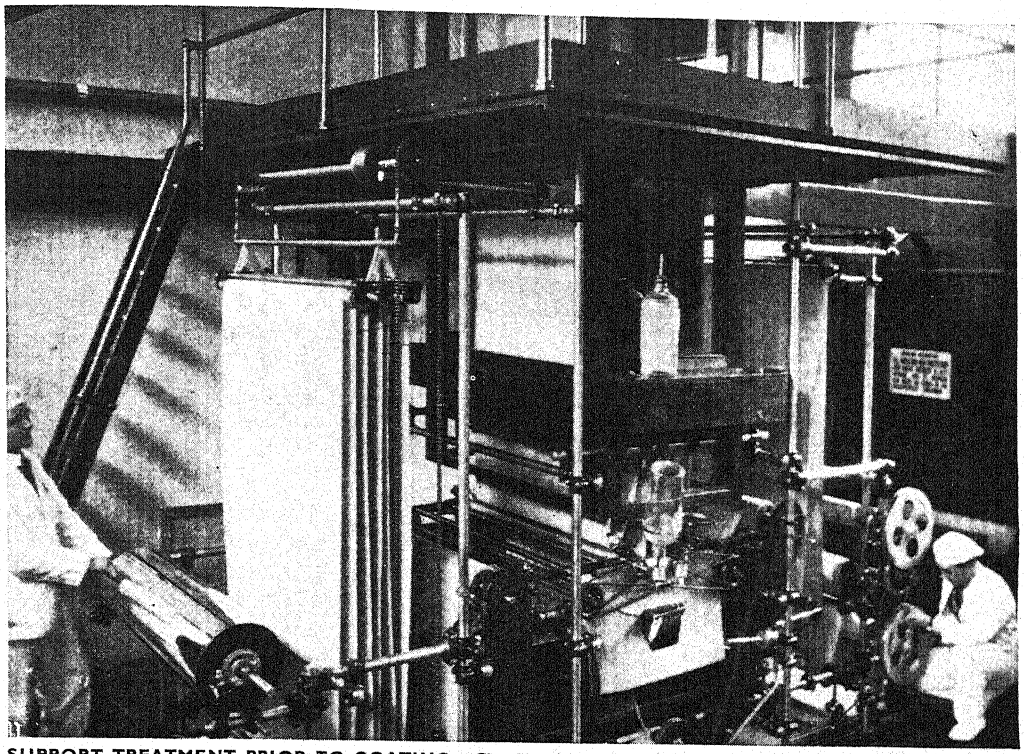


Fig. 8. Three types of film coating units shown diagrammatically. The film passes under rollers and picks up the liquid emulsion by dipping or by means of a slab feed or roller



SPREADING THE EMULSION. Fig. 9. Coating head of factory machine which automatically treats the paper or film with emulsion
Photo, Ilford, Ltd.

Coating. Emulsion is spread on to the support in liquid form, the methods used for coating being different for glass and for film or paper. The two latter being flexible and obtainable in large areas are

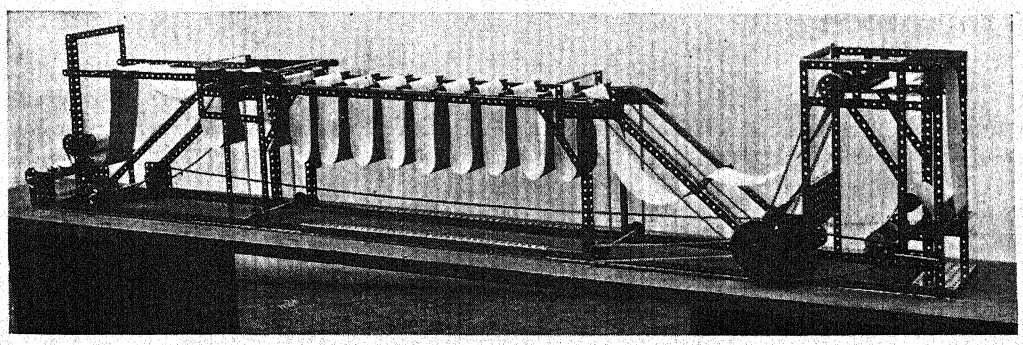


SUPPORT TREATMENT PRIOR TO COATING. **Fig. 10.** In order to obtain the necessary adhesion between celluloid film and emulsion, a substratum coating of either dilute gelatine or an etching solution of organic solvents is applied to the celluloid. The process is carried out by the machine shown above
Photo, Ilford, Ltd.

coated in rolls of one to several thousand feet long, and up to 54 inches wide, by passing the paper or film under a roller which dips into or comes in contact with a reservoir of liquid emulsion. Various forms of coating units are in commercial use, and three are shown diagrammatically in Fig. 8.

Immediately after coating, the thin layer of emulsion is set to a jell by passing the paper or film upwards through a " chill box " containing refrigerated air or over chilled metal rollers. Thereafter the material is automatically looped in festoons supported by poles and is passed slowly down a drying track some hundreds of feet in length. In the track the layer of emulsion is dried by meticulously clean air of controlled temperature, humidity, and distribution.

Finally, the dried film or paper is rehumidified, reeled and stored for slitting, chopping and packing, Fig. 9 shows the coating head of a factory machine, the general coating process being illustrated by the model shown in Fig. 11.



COATING MACHINE IN MODEL FORM. **Fig. 11.** The general arrangement of the plant used in the coating of film material is clearly revealed in this picture of the machine in model form. The film passes along a track several hundred feet in length

Glass-plate coating presents somewhat different problems from paper and film coating, and the general method employed is to pass a series of plates in contact on an endless band beneath a slot through which a thin ribbon of liquid emulsion is delivered, as illustrated diagrammatically in Fig. 12. Immediately after coating, the plates are led

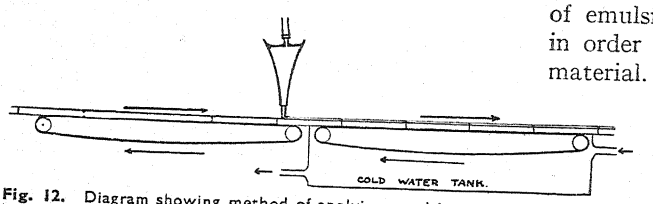


Fig. 12. Diagram showing method of applying emulsion to glass plates. The latter pass across a slot through which a ribbon of liquid emulsion is ejected

through a chill box or over a bath of cold water which just comes in contact with the under-side of the plates. After the emulsion has set, the plates are removed and dried in stacks in a drying chamber. Fig. 13 is a photograph (taken on infra-red material) of a laboratory plate-coating machine in actual operation.

Coating Weight. As photographic properties are dependent upon the thickness of emulsion coating, it is essential that the emulsion be applied and set in a uniform manner throughout the length and breadth of a roll or batch, and that the quantity applied agrees with the desired value. The quantity of silver salt per unit area is generally termed the " coating weight " and may be expressed in milligrams of metallic silver per square decimetre.



PLATE PREPARATION. **Fig. 13.** Plate-coating machine in operation in laboratory. The picture was taken by infra-red

In paper and film coating the coating weight depends upon the concentration of silver in the emulsion, the viscosity of the emulsion and the speed of coating. Accordingly, all these factors must be controlled with extreme accuracy.

Double Coating. Many modern products are coated with two or more distinct layers of emulsion with very different properties, in order to increase the " latitude " of the material. This is a term used to describe the range of exposures over which an emulsion will show a certain photographic differentiation.

There is a limiting value of exposure below which even the fastest emulsion will give no photographic effect, and similarly a maximum value above which the emulsion fails to produce any further increase in density. If the fast emulsion be coated over a relatively slow emulsion which commences to record photographically at approximately the exposure where the fast emulsion ceases to

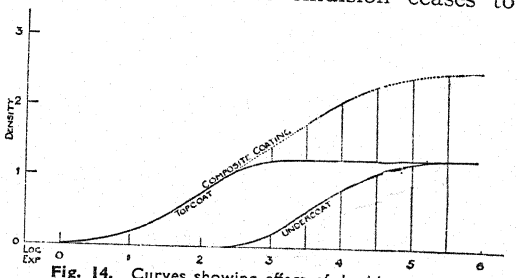


Fig. 14. Curves showing effect of double-coating

record, the latitude of the composite coating may be doubled. Over-exposure would then produce, instead of uniform dark grey, degrees of intense blackness which require merely increased printing exposure to give perfect results. The effect of double coating is demonstrated graphically in the characteristic curves shown in Fig. 14.

Gelatine Super-Coating. When a dried photographic emulsion is subjected to slight abrasion or mechanical stress insufficient to cause visible damage to the emulsion surface, the portions affected will appear on development as black markings. These marks can be shown to be due to reduced silver grains which are situated on

the surface layer only, since they may be removed by rubbing the emulsion with wet cotton-wool.

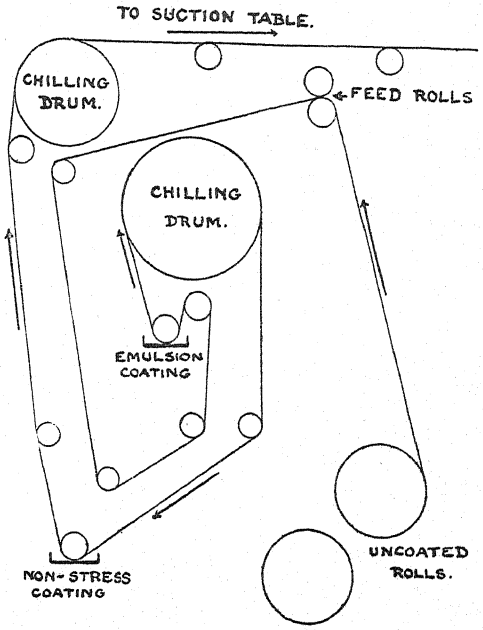
Photographic material free from liability to give these stress marks may consequently be prepared by coating the surface of the emulsion with a clear gelatine layer. This supercoating is usually applied to the set emulsion before drying on a second coating unit of the same coating head. Fig. 15 shows the layout of a double coating head, the complicated path of the film or paper being necessitated by the fact that after the first coating all passages over rollers must obviously be made with the set emulsion *outwards* in order to avoid damage thereto.

Backing. During the drying operation the emulsion layer tends to contract, and in the case of a non-rigid support like celluloid film this introduces an undesirable tendency to curl, with the emulsion side concave. Accordingly, the film base is pre-treated before emulsion coating, so that it has an equal tendency to curl in the opposite direction. In the case of X-ray films the problem cures itself since similar emulsion coatings are made on each side of the film. Roll-films and flat films are backed by a clear gelatine layer so adjusted that its contraction just balances the emulsion curl.

Of recent years, the gelatine backing layer has been utilized as the medium for carrying a disappearing anti-halation dye which prevents light reflection from the back of the film during exposure, and which is decolorized by the sulphite present in the processing solutions. Gelatine backings may also contain a fine suspension, as for example starch grains, in order to produce a matt effect.

In the case of cine films a gelatine backing would be a distinct disadvantage, and emulsion curl is counteracted by a special solvent treatment of the back of the film base itself. To mitigate halation in cine negative and kindred films, the base is permanently tinted a pale grey.

Testing of Materials and Products. It is generally not possible to induce a high sensitivity to light without also introducing a high and undesirable sensitivity to traces of impurities. Accordingly, every material which is used in the preparation of photographic emulsions, or which may subsequently come into contact with them (as support, packing materials, etc.), is subjected to rigid chemical tests and tests for photographic action. The latter are essential, since impurities may be present in chemically undetectable quantities and yet exert a deleterious photographic action.



HOW FILMS ARE DOUBLE-COATED. Fig. 15. Diagram showing arrangement of double-coating head. The intricate path of the film is necessary to avoid contact between the set emulsion and rollers after the first coating has been applied

In spite of the fact that the photographic industry uses the most expensive grade of gelatine—considerably higher than food gelatines—this raw material is the most difficult to test and control. Its sensitizing property cannot be reliably estimated by chemical tests, and no batch of gelatine is purchased until a test emulsion has been made.

Emulsions are tested photographically at various stages during manufacture, and the finished product is tested not only under conditions of use, but for statistical and record purposes by carefully controlled sensitometric tests. In addition to these tests of immediate photographic properties, exhaustive incubation tests are made to determine the keeping qualities of each batch under normal and tropical conditions of storage. Finally, every portion of material is scrupulously surface-examined before packing, to ensure that it is physically perfect.

EMULSIONS: (2) THEIR PROPERTIES SIMPLY STATED

Olaf Bloch, Hon. LL.D., F.I.C., Hon. F.R.P.S.

Chief Chemist, Ilford, Ltd.

In this second article on emulsions Dr. Bloch deals in an authoritative but highly simplified manner with modern emulsions. In particular, he explains the "characteristic curve," and thereafter discusses other matters that offer difficulties, such as speed, graininess, contrast and exposure

EMULSIONS differ in the extent to which they can satisfactorily reproduce the range of brightnesses existing in the subject photographed, and for normal subjects the recording capacity of a good emulsion is so extensive that it can far more than cover them. It is generally desired to give the least possible exposure necessary to record the required details in the shadows, and it has become usual to regard this as the *correct* exposure. It is of prime importance to realize that an emulsion cannot give satisfactory negatives for exposures shorter than the *correct* exposure as defined above, but the greater the increase of this minimum exposure which will still give a negative comprising the complete range of brightnesses of the subject, the greater the latitude of the emulsion.

As the exposures are lengthened the negative will become denser and denser and require a correspondingly longer printing time, but so long as the exposure is such that the whole scale of the subject falls within the latitude scale of the emulsion, the gradation of the prints will remain practically unaltered.

This important photographic quality can be estimated from the characteristic curve of the emulsion by the horizontal distance between the "foot" of the curve, where it commences to rise and the top of the over-exposure portion before any serious flattening out takes place. Vertical lines can be dropped from these two points on to the base line, and the latitude in terms of exposures can at once be read off as the ratio of these two readings on the relative exposure scale.

Characteristic Curve. When we expose a plate we give a uniform time of exposure to a varying range of light intensities in the subject photographed. The actual exposure given to each portion of the subject is obtained by multiplying the intensity of the light reflected from this portion by the time for which the light acts on the plate. This is the *exposure* in the sense in which the word is used in all scientific work concerning the qualities of photographic material; it is, therefore, not merely a statement of the time of the exposure, but also involves the light intensity.

The characteristic curve (*see* Curve) of an emulsion shows the relationship between the densities of the negative and the exposures which produced them. This can be obtained for several lengths of time of development, and we can thus get information which tells us all about the capacity of the emulsion for rendering shadow detail, middle tones and highlights, the rate of growth of contrast with increasing time of development, the latitude of the emulsion, *i.e.* the total range of brightnesses of a subject with which it is capable of dealing, and so forth.

It will be evident that according to the subject and the exposure the densities of the resulting negative will fall within different regions of the characteristic curve. In what follows it will be assumed that the subject is an average one and the exposure given was just sufficient to record full shadow detail.

The Three Portions. The curve may be divided into portions: (*a*) *The curved under-exposure portion or "foot."* This is that part of the range of the characteristic curve which is employed in recording the shadows and more or less of the middle tones of a normal subject. The under-exposure curve may be longer, as in the case of a portrait emulsion, or shorter as in the case of an emulsion used for general purposes where greater contrast in the shadows is desirable. The angle of slope and the range of this part of the curve are not without importance. If it is too flat the shadows will be found to

lack that richness which is so necessary to give them life, and if too prolonged the middle tones will suffer from flatness in consequence.

(*b*) *The straight-line portion.* This is the portion of the curve in which equal *percentage* increments in exposure produce equal increments in density. The slope of this part is responsible for the contrast in the middle tones and more or less of the high-lights in a subject of average range, and in selecting a plate for any particular purpose it is important to note that the total contrast of the negative is greatly influenced by the time of development which is the factor that controls the slope of this straight-line portion of the curve.

(*c*) *The over-exposure portion.* This is the counterpart of the under-exposure portion of the curve, but the curvature is opposite. It should not flatten out too rapidly, otherwise the extreme high-lights become weak. On the other hand, this portion of the curve is of definite advantage in circumstances where printable skies and gradation in the strong high-lights are desired, because the densities do not tend to build up so rapidly as if the straight-line portion of the curve were continuous.

Speed. It is not proposed to enter upon a discussion of this much vexed subject. The fact that it is only just possible in practice to distinguish a difference of 20 per cent. in speed between two similar emulsions can be taken advantage of to provide us with a rational system of speed rating. Leaving the slow process materials out of consideration, as these form a class by themselves, we are able to divide plates into five main speed groups with sufficient speed difference between each group and the next to give the division a real meaning, since each group is approximately double the speed of the group below it and half the speed of the group above it. This replaces the misleading system of speed numbers which, taken by themselves apart from the other properties of the emulsion, mean very much less than they appear to do. We are thus able to classify our emulsions on a much broader and far more practical basis, and we are convinced that all photographers will welcome the introduction of a rational system. This classification has been adopted by Messrs. Ilford, Ltd., in connexion with their photo-electric exposure meter, where materials are grouped in five distinct classes ranging from A—slow to E—ultra-rapid (*see further under main heading* Graininess).

Graininess. With the popularization of small and miniature cameras, enlarging has become a necessity, and since today it is often desired to make as big an enlargement from a 35-mm. negative as used to be required from a quarter-plate, and with no more evidence of grain in the enlargement, it has become absolutely imperative to produce types of emulsions which would accomplish this satisfactorily.

Generally it may be said that increasing speed is accompanied by increasing graininess, but the skill of the emulsion maker has enabled him to improve his products so that the fastest emulsions of today are no coarser in grain than the medium speed ones of yesterday. This property can be rationally classified in a similar way to speed.

Contrast. Varying degrees of contrast are required for varying photographic purposes, and the time and temperature development tables usually supplied enable the photographer to control this with ease. It is always possible to decrease or increase the contrast of a negative by shortening or prolonging the time of development, but there is always the risk that this may throw the whole tonal scale out of balance, and for this reason it is best to use an emulsion for the purpose for which it has been specifically designed. Here again a rational system of contrast grouping can be adopted. (*See further under* Contrast *and* Negative, Density and Tone Values.)

Exposure. Exposure is a subject that has been so much discussed that it is not necessary to deal with it here in detail, but it cannot be too strongly emphasized that however great the " latitude " of an emulsion may be, it is " latitude " on the full exposure side. Under-exposure *cannot* be subsequently corrected. If the exposure has been so brief as to fail to register some of the shadow detail, no amount of doctoring will put into the negative anything that does not already pre-exist in the exposed but undeveloped plate. Therefore a knowledge of the approximately correct exposure is of first importance. (*see* Exposure *and* Exposure Meters).

ENLARGERS & ENLARGING: (1) AMATEUR METHODS

F. J. Mortimer, Hon. F.R.P.S.

Editor of 'The Amateur Photographer' and 'Photograms of the Year'

Practically all photographic prints of importance (apart from album snapshots), whether amateur or professional, now represent some degree of enlargement, and for miniature camera work enlargement is essential. Therefore enlarging is a major photographic process, and both it and the apparatus employed are treated accordingly in this work.

The matter presented, following Mr. Mortimer's survey of amateur methods, is :

ENLARGERS AND ENLARGING : (2) Commercial, by W. G. Briggs, F.R.P.S.
(3) Daylight Methods, by Bernard Alfieri, Jr.
(4) Picture Making, by Emslie Dean
(5) Shading Control, by G. K. Seager
(6) Choice of Apparatus, Vertical and Horizontal Enlargers, by David Charles, F.R.P.S., and others
(7) A Selection of Modern Enlargers
(8) Home-Made Enlarging Lantern, by S. G. B. Stubbs
(9) Aids to Enlarging, by various writers
(10) Enlarging from Cine Frames

See also such headings as Bromide Prints ; Exhibition Prints ; Working-Up, etc.

TODAY the making of prints by enlarging has become almost a necessity for the amateur photographer. This state of things has been brought about by the increase in the use of miniature cameras, the negatives from which vary from an inch square to $2\frac{1}{4}$ inches square, and are produced at the present time in hundreds of thousands. While the largest size of these permits of contact prints that are just possible to view with comfort (although still on the small side), anything smaller, particularly the other popular sizes such as 4 × 6.5 cm. and 24 × 36 mm., is inadequate for contact prints, and the only way to appreciate pictures from these negatives is to make them with an enlarger.

Although the making of enlargements from negatives of all sizes has always been a regular part of photographic procedure, the increasing practice of enlarging from miniature negatives has brought in its train a great development in the design and construction of enlargers, which have now become part of the outfit of every serious worker.

Enlarging is printing by projection. That is to say, instead of the sensitive paper being in contact with the negative it is some distance from the negative and the image, with a strong light behind it, is projected by means of a lens on to its surface. The size of this image increases the farther away it is from the projecting lens.

There are two main divisions: "horizontal" and "vertical" enlargers. The first projects the image in a horizontal direction on to an upright easel holding the bromide or chloro-bromide paper, and the second projects the image vertically downwards on to the equivalent of an easel lying flat. They are fully described in a later part of this section.

There is also the daylight enlarger, but this is now practically obsolete (*see* Daylight Methods, page 654).

Although the horizontal enlarger is gradually being displaced by the vertical, there are many points in its favour, notably the fact that the size of enlargement is only limited by the length of the room in which the enlarger is used, and also it is capable of many adjustments that are not so easily made with the vertical type.

The Condenser. Theoretically, in a condenser enlarger the light should be small and concentrated, and the condenser, which normally consists of two plano-convex lenses held face to face in a metal collar with the convex surfaces nearly touching, should be of such a size that the diameter is slightly in excess of the diameter of the plate or film to be enlarged.

The function of the condenser as an optical part of the enlarger is to gather all available divergent or parallel rays of light from the illuminant (when it is correctly placed in relation to the condenser) so as to concentrate the illumination upon a limited area. The negative is placed close to the condenser and is evenly illuminated. The beam of light passing through the negative is then brought to a focus at the point where the projecting lens is situated.

In actual practice, however, a considerable amount of light is scattered owing to the fact that the illuminant is not usually a point of light, and the average condenser does not condense as a true cone.

The negative is placed in a carrier that slides in a grooved space in the enlarger, as close as possible to the flat outer side of the condenser, and is held in the carrier up-side down if the image is to be projected the right way up on the easel. The bellows between that part of the enlarger holding the carrier and the lens panel should be capable of extension to at least twice the focal length of the lens.

The Lens. The enlarging lens should be a properly corrected objective and not the type that is usually fitted to lanterns for projecting lantern slides. This photographic quality is necessary to enable the visual and actinic images to coincide. The lantern-slide projector lens is generally only corrected for the visual image. For this reason it is frequently advocated that the lens from the camera that took the negative in the first place is also the best lens for fitting to the enlarger for making enlargements, particularly if it can be opened to a large aperture.

The focal length of the lens should be approximately the same as the diameter of the condenser. A $5\frac{1}{2}$-in. condenser works at its best with a $5\frac{1}{2}$-in. projecting lens. If the lens is a properly corrected anastigmat it will be found that it is capable of being used at full aperture, as the problem is merely to project an image from one plane surface, *i.e.* the negative, to another plane surface, *i.e.* the bromide paper. If the lens is stopped down for any purpose, or when any alteration of focus is made, the light should be tested for correct centring. To do this the negative carrier must be removed, and if the disk of light thrown on to the easel is not clear and at its brightest, the lamp in the enlarger should be shifted forward or backward, up or down or sideways until it is clear. The negative carrier is then replaced.

A dark yellow glass cap should be fitted to the enlarger lens to allow the image to be projected and seen on the easel without fogging the bromide paper. Focussing should never be attempted through the yellow glass, but it allows the bromide paper to be put into position after focussing.

Condenserless enlargers do not require the same care in centring the light, as this is usually adjusted in the first instance, and with the aid of reflectors the best volume of light is then thrown forward through a diffusing screen, of ground glass, which is immediately behind the negative.

Easel or Board? With horizontal enlargers the bromide paper is generally pinned to the surface of the easel by means of four dark-room pins, one at each corner. There are, however, easels on the market, and some that are home-made, in which other contrivances can be made to hold the paper flat in position, such as strips of wood or rubber bands, but in practice the pins are usually found most convenient.

With vertical enlargers the sensitive paper is held flat on the enlarging board either by a small adjustable mask which grips it all the way round, and at the same time leaves a white margin, or is held down in position by a sheet of clear plate glass through which the image is projected.

In many of the vertical enlargers, particularly those that are intended for use with tiny 35-mm. negatives, the illuminant is an opal electric bulb of high wattage, the effective area of which is large enough to cover the entire surface of the negative. When such a bulb is enclosed in a suitable basin-shaped reflector, the illumination of the negative is even enough to dispense with the use of a condenser.

Scale Calculations. Some of the modern vertical enlargers have a still further refinement in all their adjustments, being automatic in character. As will be described later, the scale of enlarging depends on the focal length of the projecting lens, and its position in relation to the negative on one hand and the sensitive paper on the other. These two distances bear a strict relation to each other and are known as the conjugate foci. In enlarging the distance from the negative to the lens is the lesser conjugate focus, and that from the lens to the bromide paper is the greater conjugate focus. As the greater conjugate focus is increased—that is, as the bromide paper is taken further from the lens—the image becomes larger and a greater degree of enlargement is secured in the final picture. At the same time, to secure a sharp image the lesser conjugate focus must be reduced—that is, the lens is placed nearer to the negative. A table which is given here shows the distances of the conjugate foci with lenses

of different focal length for different degrees of enlargement.

ENLARGING FORMULAE

The following formula can be used to ascertain the conjugate foci for any size enlargement :

Let F = the focal length of the lens.
A = the distance between lens and negative.
B = the distance between lens and easel.
Then A = (F ÷ Numbers of enlargements of negative) + F.
B = (F × Numbers of enlargements of negative) + F.

E.g. It is desired to enlarge a negative 3 times and the focal length of the enlarging lens is 5 in. What should be the distances between negative and lens (A) and between lens and easel (B)?

A = (5 in. ÷ 3) + 5 in. = $1\frac{2}{3}$ + 5 = $6\frac{2}{3}$ in.
B = (5 in. × 3) + 5 in. = 15 + 5 = 20 in.

ENLARGING TABLE

The following table gives the distances in inches from the negative to the lens (lower figure) and from the lens to the easel or enlarging board (top figure) for lenses of focal lengths from 2 in. to 8 in. :

Focal length of lens in inches	TIMES OF ENLARGEMENT						
	2	3	4	5	6	7	8
2	6	8	10	12	14	16	18
	3	$2\frac{2}{3}$	$2\frac{1}{2}$	$2\frac{2}{5}$	$2\frac{1}{3}$	$2\frac{2}{7}$	$2\frac{1}{4}$
$2\frac{1}{2}$	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$
	$3\frac{3}{4}$	$3\frac{1}{3}$	$3\frac{1}{8}$	3	3	$2\frac{6}{7}$	$2\frac{3}{4}$
3	9	12	15	18	21	24	27
	$4\frac{1}{2}$	4	$3\frac{3}{4}$	$3\frac{3}{5}$	$3\frac{1}{2}$	$3\frac{3}{7}$	$3\frac{3}{8}$
$3\frac{1}{2}$	$10\frac{1}{2}$	14	$17\frac{1}{2}$	21	$24\frac{1}{2}$	28	$31\frac{1}{2}$
	$5\frac{1}{4}$	$4\frac{2}{3}$	$4\frac{3}{8}$	$4\frac{1}{5}$	4	4	4
4	12	16	20	24	28	32	36
	6	$5\frac{1}{3}$	5	$4\frac{4}{5}$	$4\frac{2}{3}$	$4\frac{1}{2}$	$4\frac{1}{2}$
$4\frac{1}{2}$	$13\frac{1}{2}$	18	$22\frac{1}{2}$	27	$31\frac{1}{2}$	36	$40\frac{1}{2}$
	$6\frac{3}{4}$	6	$5\frac{5}{8}$	$5\frac{2}{5}$	$5\frac{1}{4}$	$5\frac{1}{7}$	5
5	15	20	25	30	35	40	45
	$7\frac{1}{2}$	$6\frac{2}{3}$	$6\frac{1}{4}$	6	$6\frac{1}{6}$	$6\frac{2}{7}$	$5\frac{5}{8}$
$5\frac{1}{2}$	$16\frac{1}{2}$	22	$27\frac{1}{2}$	33	$38\frac{1}{2}$	44	$49\frac{1}{2}$
	$8\frac{1}{4}$	$7\frac{1}{3}$	$6\frac{7}{8}$	$6\frac{3}{5}$	$6\frac{5}{12}$	$6\frac{2}{7}$	$6\frac{1}{16}$
6	18	24	30	36	42	48	54
	9	8	$7\frac{1}{2}$	$7\frac{1}{5}$	7	$6\frac{6}{7}$	$6\frac{3}{4}$
7	21	28	35	42	49	56	63
	$10\frac{1}{2}$	$9\frac{1}{3}$	$8\frac{3}{4}$	$8\frac{2}{5}$	$8\frac{1}{6}$	8	$7\frac{7}{8}$
8	24	32	40	48	56	64	72
	12	$10\frac{2}{3}$	10	$9\frac{3}{5}$	$9\frac{1}{3}$	$9\frac{1}{7}$	9

First ascertain the focal length of lens in enlarger. Then decide on number of times enlargement to be made. This is found by comparing the length of diagonal of the negative with that of the enlargement decided on.

The point of intersection of the vertical and horizontal columns gives the distances required.

The greater of the two numbers where the two intersect is the distance from lens to the sensitive paper. The lesser is the distance from lens to negative.

As these distances always bear a definite relation to one another it has been possible to construct enlargers that automatically adjust themselves to the correct relative distances by a system of gears and levers. All that is necessary with them to produce any particular size enlargement is merely to move the lever to alter the distance between the lens and the easel holding the bromide paper to secure the right degree of enlargement. This automatically adjusts the distance between the lens and the negative to get correct focus. For the worker with a variety of subjects, particularly if his negatives are sharp and of good quality, and a number of prints are wanted quickly, this type of enlarger has an enormous advantage over any other if only as a time-saver.

Adjustment. When starting to make an enlargement, particularly if a beginner is attempting it for the first time, the matter of obtaining the right size of enlargement and correct focus will appear much more difficult than it really is. This difficulty, of course, does not arise if an automatic focussing enlarger is being used ; but with any other type, both horizontal and vertical, certain adjustments have to be made before the exact size picture can be obtained. We will assume that the enlarger is all in readiness for use, the negative has been placed in the carrier, the light turned on, and the lens is projecting a blurred image on to the white paper on the enlarging board or easel. The problem is to turn the blurred image into a sharp one of the correct size, to fit a certain space or size of bromide paper.

The first thing to do will be to alter the distance of the lens in relation to the enlarging board, or easel, putting it nearer or farther away. It will be found that at one point the image will become sharp, but it may also be found that it is the wrong size. We have, however, learnt from this that an enlargement of that size is obtainable with the lens in that position. If a bigger image is required the distance between the lens and the enlarging board must be increased.

When the image becomes approximately the correct size required, it will be found to be out of focus again. The final adjustment should now be made by altering the distance between the lens and the negative. If the image has been made bigger by the first movement, the distance between the negative and the lens should now be made smaller. With a horizontal enlarger this means racking back the lens, and the same applies to the vertical type. A point will soon be reached when the image becomes sharp, and if the size is not precisely what is required the same operation can be repeated little by little until it is correct.

If the out-of-focus image in the first case is too large, the easel is first brought nearer to the lens and the lens is then taken farther from the negative until the picture is rendered sharp. When this has been done (in the case of a horizontal condenser

enlarger) the light should be tested for correct centring to get the best illumination.

When focussing the enlargement a piece of white paper or card can be affixed to the easel, either horizontally or vertically, for this purpose. In many types of enlarging easels the entire surface is covered with white paper, which is ruled in various sizes, indicating the degree of enlargement for the finished picture.

With this system it may be assumed that the worker knows beforehand the size to which he desires to enlarge, and has paper available for that purpose. A better plan, however, particularly for the easel with a horizontal enlarger, is to have the surface black and use a number of pieces of stiff white paper cut to the standard sizes of bromide paper for enlarging, such as half-plate, whole-plate, 10 × 8, 12 × 10, 15 × 12, etc. It will be found that if a piece of white paper of the correct size is pinned to the black surface of the easel it is much easier to see the image, or whatever portion of it is being enlarged on this space with the remainder of the image lost in the black background. It is also possible when choosing a small portion of the enlarged image, which may cover the entire surface of the easel, to move the piece of white paper, which represents the bromide paper, from place to place on the surface of the easel until the right proportion of composition is included.

Negative and Paper Contrast. The two chief things to be considered when making enlargements are : (1) the character of the negative in the matter of density and contrast ; (2) the speed and contrast quality of the sensitive paper on which the enlargement is made. The best prints will only be secured when these two factors are satisfactorily adjusted.

It would, for instance, be absurd to attempt to enlarge a negative that is already harsh in contrast, from over-development, on bromide paper made for contrasty results.

If a number of negatives are to be enlarged they should be sorted into three groups : (1) those that are thin and inclined to be flat in quality ; (2) those that are a little denser (but not too dense) and have a good range of tones from highlights to shadows, and which are described as " normal," and (3) those that are over-dense and harsh.

Each of these groups will require a different exposure and a different grade of paper to obtain the best results. The first group will require a paper that is generally labelled by the makers as " contrasty," and which ordinarily gives a print with the contrasts accentuated ; the second group will need one known as " normal " paper, and is the ideal combination for making good enlargements ; the third will want a paper that is faster in speed and described as " soft " grade.

In addition, the time of exposure must be ascertained by trial strips, made actually on the easel itself at the correct degree of enlargement. This method is described and illustrated under the heading " Bromide Printing " (page 198).

Apart from the density and contrast quality of the negative for enlarging which have to be considered, care should be taken to observe that the film surface is free from mechanical defects, such as pin-holes, scratches, etc. These, particularly with a condenser enlarger, become intensified to an alarming extent in the final enlargement. Very careful spotting should therefore be undertaken before enlarging, as it is always best to turn a pin-hole in a negative into a small black spot rather than leave it. It will then appear as a white spot on the enlargement, and this is easier to fill in than to remove a black spot.

Control. A great deal of control can be exercised by the worker when making a direct enlargement. Control in this case means increase of exposure in any particular part of the enlargement, or holding back the action of light in other portions by means of suitable masks. For instance, when enlarging a landscape subject, the sky portion of the negative may be found to be too dense in character to permit clouds to print through fully at the same time as the foreground. It is necessary, therefore, for the sky to receive an increased exposure to even up the tones of the picture. The simplest manner of doing this is by means of a piece of thin opaque card, one edge of which can be roughly torn to approximate the outline of the skyline. This is held in the rays from the projecting lens to intercept that portion of the image containing the foreground, and shades it while the sky is receiving a prolonged exposure.

During this shading action the card should be kept in slight movement both up and down and to and fro between the lens and the bromide paper. By this means no dividing line will show where the print has been masked, and after a little practice this can be so done that the sky can be fully printed without any overlap on to the landscape portion.

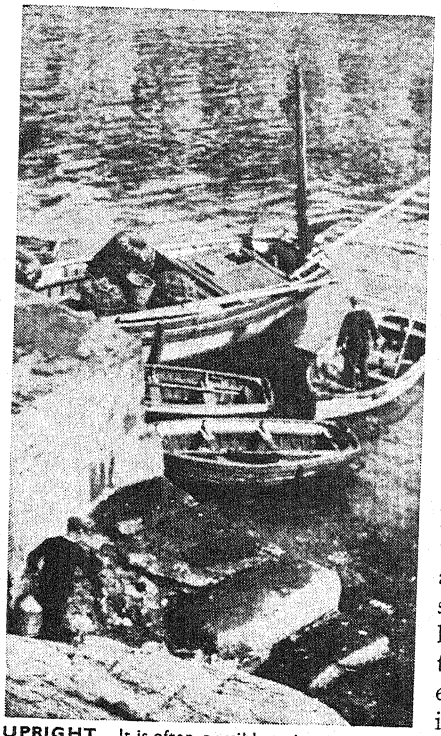
When, however, one spot or smaller area in the picture needs an increase of exposure in relation to the rest of the subject, the same procedure is followed, but for this purpose an opaque card, in which a hole has been made, is used. This, held between the lens and the easel, is kept in slight movement.

The reverse of this occurs when a small area in the picture prints too darkly and has to be shielded from light while the remainder receives the full exposure.

In this case a tuft of cotton-wool, or a small piece of card of convenient shape, is fixed to the end of a long, thin stiff wire. This, held between the lens and the easel, will cast a shadow that varies in size according to its distance from the easel. The wire is practically invisible, and the cotton-wool, which shades the desired spot, can be pulled into any shape required. It should be kept in slight motion.

A further development is to print in clouds in a landscape picture from another negative. In this case the sky portion of the landscape is masked while the foreground is being exposed, so that if the print were developed at this stage the sky would be perfectly blank (*see* Combination Printing *and* Clouds).

It is desirable that both the foreground portion and the clouds should be made the subject of test strips, so that the correct exposure can be given for each ; one may require two or three times as long as the other. The entire print, if the masking has been carefully done, can then be developed as a complete picture, and there should be no evidence of the sky having been printed in.



UPRIGHT. It is often possible to improve on an original photograph by enlarging a selected portion of the whole and cutting out superfluous areas, as shown in page 643. Here is an upright so treated

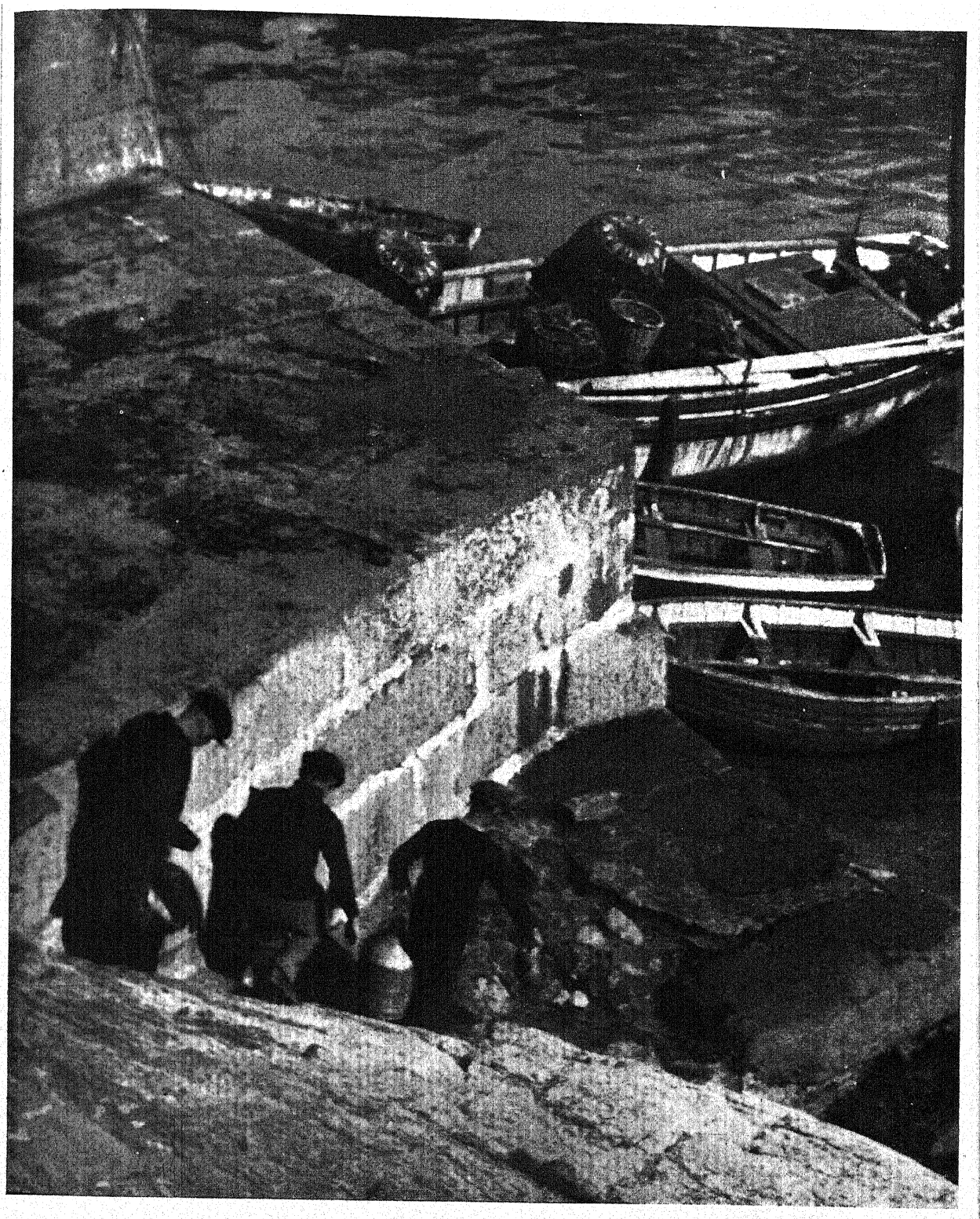
Pictures Within Pictures. The necessity for enlarging practically every negative taken with modern miniature cameras has not only introduced the technique of making an enlargement to thousands of new amateurs, but has drawn their attention to the possibilities of the enlarger for picture-making, by selecting small portions of the subject for further enlargement as complete compositions. The beginner, however, is never fully aware of the real utility of this, and his tendency is to enlarge the whole of the negative, or, if he does realize that a part is sometimes greater than the whole (pictorially speaking), he is never adventurous enough to examine the small original to see how many pictures it contains.

The procedure is as follows : First make a straight enlargement, say whole-plate or

[*Continued in page* 647



OBLONG. Here is another version of the upper photograph in this page. The original foreground and background have been eliminated, but the right-hand portion has been retained to give a different effect



THE THREE FISHERS F. J. Mortimer,

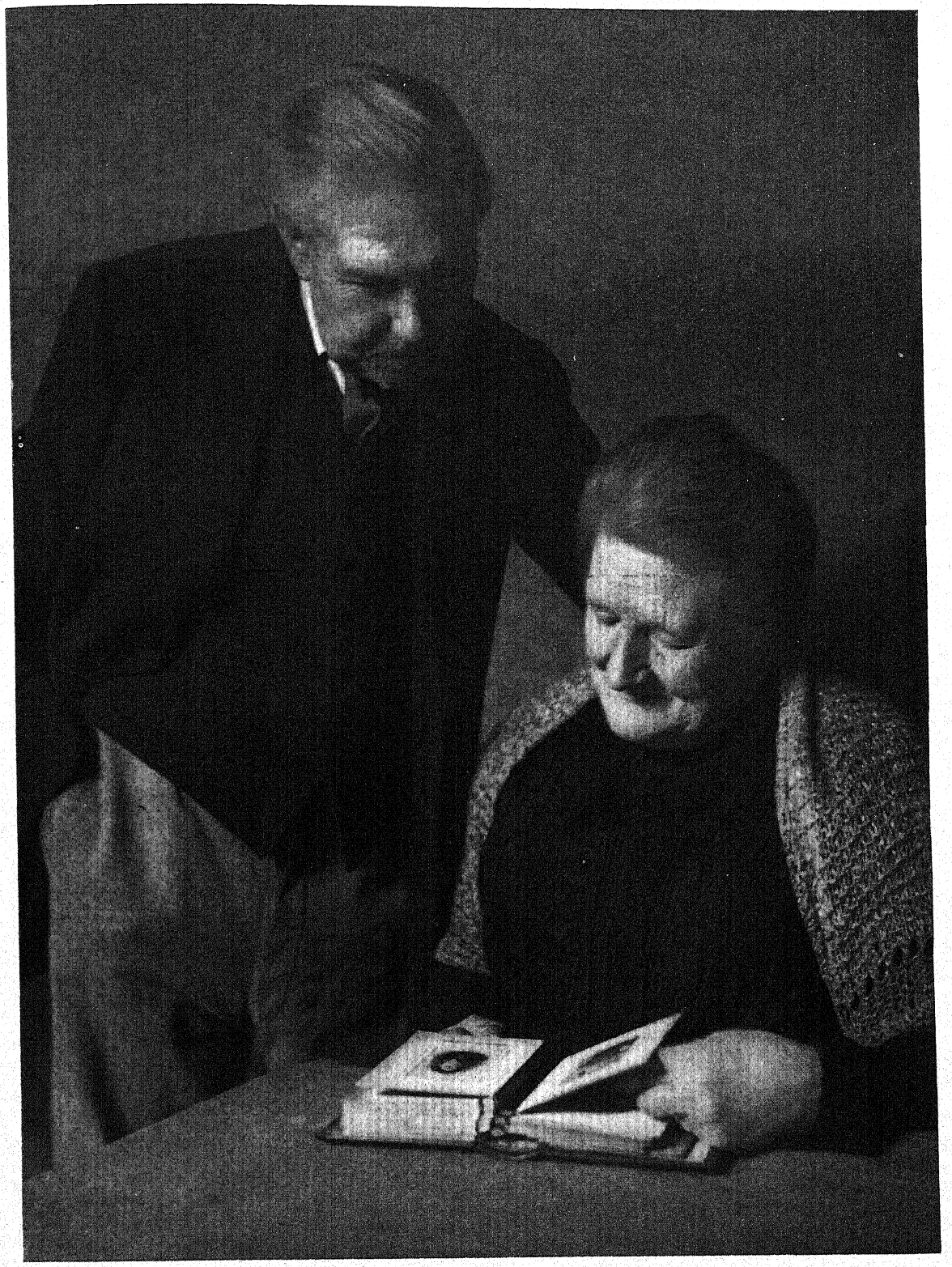
Hypersensitive pan. film; 1/100 sec. at f8; photo taken at 4 p.m. in August; negative developed in neat Rodinal. *(See article Enlargers and Enlarging, pages 656-657)*



***A** STREAM IN OXSHOTT WOODS*

Prizewinning-picture in the "Modern Encyclopedia of Photography" Competition. Kodak Panatomic film; 1/50 sec. at f5.6; light yellow filter

R. Douglas Paul



LOOKING BACK

F. J. Zenas Carter, A.R.P.S.

Prizewinning picture in the "Modern Encyclopedia of Photography" Competition; afternoon light, November; Cooke f3.5 lens; Ilford S.G. Pan. quarter-plate; bulb exposure

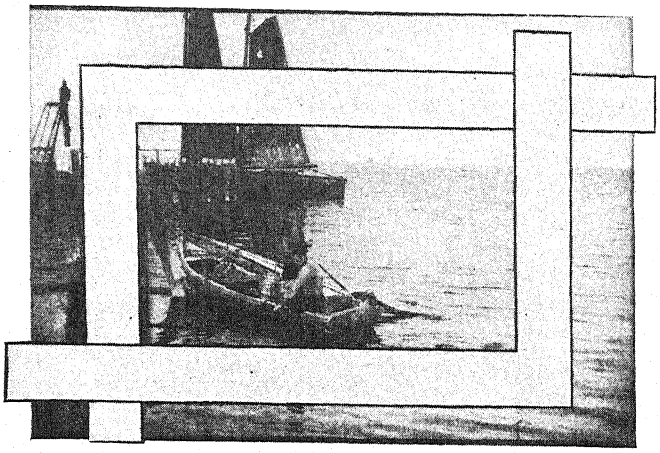


THE STREET MUSICIAN

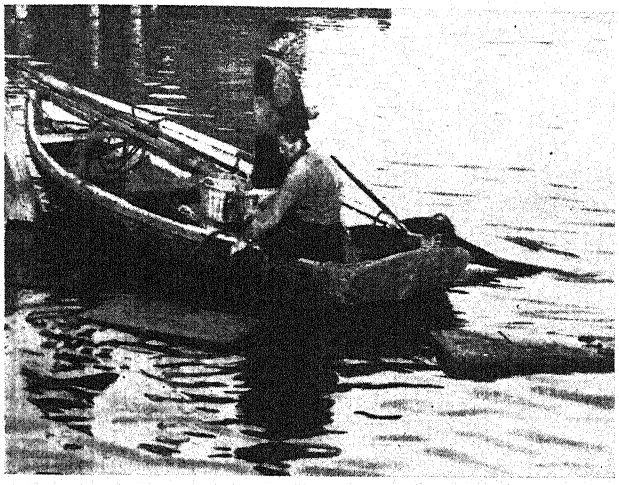
Exhibition photograph from the London Salon of Photography, 1936; Adiar Mark II 8-in. lens; Agfa Isochrome Plate; 1/2 sec. at f4.5; yellow filter

Madame Yevonde

larger, of the complete negative. When dry proceed to mask out different parts of the subject to find attractive bits or groups that can be enlarged separately as complete pictures. The easiest way to do this is to employ two L-shaped pieces of thin white card, the legs of which are at least as long as the width of the print. One is crossed over the other to form a right-angled frame, the opening of which can be altered to any size or shape by sliding the pieces about. This mask placed on the print and moved all over its surface



PORTION FROM THE WHOLE By means of two right-angle cards placed on a print as seen above it is possible to select that part of the picture most suitable for enlargement without difficulty. The improved result due to cutting and enlarging is clearly revealed in the lower photograph



will mask off various sections of the subject from their surroundings by the white frame.

When a small section has finally been selected the enlarger is brought into use and that particular rectangle focussed up to the desired size. It is then—if the negative is a good one—that the beauties of the detail secured will be disclosed.

Apart from the selection of particular figures, groups and other bits from a complete shot, the trimming of these portions affords a further exercise for the picture-seeker. He will be surprised how many alternative shapes may be employed with the same figure or figures, and yet each produce an attractive composition.

When the worker becomes more expert and observant he will find that it is not always necessary to make a print and mask it in the manner described. Provided the negative is not too large and the masking arrangements on the easel of the vertical enlarger are readily adjusted, the choice of subject can be done with the projected negative image only. This will add a still further fascination to making enlargements from small negatives, and particularly applies to the 35-mm. miniature camera strip negatives that can be run through the enlarger until a likely subject appears. It can then have the various maskings adjusted in conjunction with different degrees of enlargement.

Correcting Verticals. A feature of the easel on horizontal enlargers that is particularly useful is that it can be swung out of the perpendicular and used in that position for correcting vertical lines in negatives where they are converging. It is possible also to do this with upright enlargers, by lifting one side of the enlarging board, but the adjustments are not so readily made as with the old style horizontal type of enlarger, where both the easel and the carrier can be swung out of the vertical to correct the distorted image.

The principle, however, is the same, and it is an application of the fact that the farther



STRAIGHT AND DIFFUSED PRINTS. The hard, dark shadow seen in the left photograph was removed during enlargement by placing the hand midway between the lens and paper. Afterwards extra exposure was given to the denser areas, with the result shown on the right

the easel is from the lens the larger the projected image grows. If, therefore, one part of the easel, or enlarging board, can be kept at its normal position, and the other end placed farther away, that part of the image which is farther away will be more enlarged.

With most of the modern cameras that are minus any adjustment in the shape of a rising front or swing back, which in the older cameras enabled architectural subjects with parallel vertical lines to be rendered truly in the negative to include the top of the subject, it is necessary now to point the camera upwards. The result of this is that parallel vertical lines converge towards the top and, in the print, give the impression of the building falling over. When a negative of such a subject is placed in the enlarger the top part of the picture can be projected on to a slanting easel, so that that portion receives greater enlargement and restores the vertical lines to their correct position. As this necessarily throws the extended part of the image out of focus a small stop must be used to sharpen up the entire picture. The ideal method is, after the correct angle of the easel has been turned to correct the distortion, the focussing should be adjusted for the centre of the picture. Such a small stop will not then be necessary to sharpen both the top and the bottom of the image (*see* Architectural Photography; Distortion).

Aid to Focussing. To secure fine focussing when enlarging, it is a convenience to use a specially prepared line negative to focus on. This is a negative similar in size to the one that is to be enlarged, but which has been scratched over with a needle-point to make fine clean-cut lines extending in every direction. These lines can be focussed more readily than the image itself and, when the correct focus has been obtained, the line negative is replaced with the original one.

When enlarging from glass plates no difficulty will be experienced in holding them in the carrier of the enlarger. Films, however, should be sandwiched between two pieces of clean thin glass of the correct size to hold them flat.

Various methods of diffusing the sharpness of the projected image have been put forward from time to time when it is desired to introduce a softness in the finished picture. The most obvious way, of course, is to throw the image slightly out of focus when making the enlargement. This can be adjusted by a slight turn of focussing screw on the enlarger. The most popular of other methods is to employ either a special diffusing lens, which is fitted to the lens of the enlarger and introduces a certain amount of softness, or to hold between the lens and the enlargement during exposure a piece of tulle, or bolting silk, sandwiched between two pieces of glass. One or two thicknesses may be used according to the amount of diffusion.

Finally, when undertaking enlarging, the dark-room and work bench should be in proper order for dealing with the task; dishes for water, developer, and fixing should be ready, and the safelight, which should be yellow or orange, should be conveniently placed for dealing with the print, but shielded from the enlarging board, otherwise it will be difficult to judge the depth of the image on the white paper if it is also illuminated by the yellow safelight.

Care should also be taken to test the entire dark-room for light leakages, which frequently come from various parts of the enlarger itself and may prove to be an unsuspected cause of fogged prints.

The developing and fixing of the enlarged bromide or chloro-bromide print is proceeded with in precisely the same way as for ordinary bromide or chloro-bromide printing described under their respective headings.

ENLARGERS & ENLARGING: (2) COMMERCIAL

W. G. Briggs, F.R.P.S.

The process of enlarging is a branch of the professional photographer's work upon which his reputation as a craftsman largely depends, and in order to produce high-class prints it is essential that his methods and apparatus be of a high order. In this article the matter of photographic enlargement from the commercial standpoint is discussed from every angle. Other articles in this series which amplify the present include Hints on Choosing Enlargers and one giving a selection of modern enlargers

THE practice of supplying clients with enlargements is much more general in commercial photographic studios now than was the custom a few years ago. It was then usual to expose 12 × 10, or even 15 × 12 plates, from which contact prints were supplied. This use of large plates is to an extent now only practised by a few specialists in technical photography; the more general run of commercial studios frequently enlarge to the required size from whole plate, or even smaller if circumstances indicate that such a size of negative is more likely to give the desired result.

Advantages of Enlargements. Many workers contend that a better result can be obtained and greater satisfaction given to the client by supplying enlargements instead of contact prints. The fine quality of modern sensitized material, and the opportunity a flexible negative size gives to the operator to get the best photographically from a given subject owing to greater ranges of lenses and equipment available, plus a much greater degree of control possible with a projected print as against a contact print, enables the intelligent worker to use the most suitable equipment and, by judicious control during enlarging, to produce a result superior to a contact print from a larger negative.

It will be obvious to the seller and buyer alike that, if the process of enlarging be adopted, it must not be apparent. The only real argument in favour of using an enlargement as against a contact print is that it should give the best result. Nothing must be permitted that will indicate a falling off of the quality when compared with a contact print. An enlargement from a whole plate to a 15 × 12 should be indistinguishable from a 15 × 12 contact print.

To Ensure Success. To obtain this degree of perfection in enlarging it will be necessary to have equipment and craftsmanship of the highest order. The negative must be absolutely sharp, correctly exposed and developed to the right degree of contrast for projection printing. It must be free from dust spots and other evidence of careless working, and it must be free from any fault which the process of enlarging would tend to exaggerate.

Whichever type of apparatus is used, every precaution must be taken to ensure its absolute rigidity and freedom from wall or floor vibration. The lenses used must be capable at full aperture of covering to the extreme edges the size of negative to be enlarged, and every stage of the operational work must be skilfully executed.

As quite a large proportion of the prints emanating from a commercial studio will be for one or other of the reproduction processes, it is of vital importance that the enlargement be needle sharp, with good gradation and contrast, carrying full detail in all the tones through shadows to highlights.

Choice of Apparatus. The ultimate choice of enlarger will depend on such factors as cost and the amount of accommodation available. If there is plenty of space, if the printing room is of a height of 10 feet or more, and the volume of work justifies such an expenditure, it may be advisable to have both a vertical and a horizontal enlarger installed.

The advantages of the horizontal apparatus are its lower cost, the fact that it can be used in a room with a low ceiling, and its flexibility. This is due to the fact that the size of the enlargement obtainable by its use is limited only by the distance available between the easel and the enlarger. By reason of its construction it is also capable of making reductions to a greater degree than the vertical type.

Against this, the advantages of the vertical type are the small amount of floor space it

occupies, its considerably speedier working and the very great facilities it offers for control during enlarging, owing to the enlarging table being of a convenient height and in a normal horizontal position.

The auto-focus type of vertical enlarger is constructed so that whatever the relative positions of the negative and enlarging table, the enlargement made is always needle-sharp. This is, obviously, a very considerable time-saver, as fine adjustment and frequent checking for size is rendered unnecessary. Its extra cost is more than compensated for by the speed of production. It is, by the very reason of its construction, less flexible in the matter of size than the non-automatic type, having a maximum range of enlargements up to from 3 to 5 times, and on most types very little reduction is possible. The non-automatic type will allow for the substitution of different lenses of varying focal lengths in order to get the extreme degrees of enlargements or reductions that are occasionally required. If the general run of business includes a demand for enlargements exceeding 30 × 20 in., or for lantern slides from ½ or 1/1 plate negatives it will be advisable to have an extra lens panel fitted with short and long focus lenses of equal covering power, capable of being quickly substituted for the normal lens.

Illuminants. For the general run of commercial work it will be found that the half-watt system of illumination is preferable to that of mercury vapour, as mercury vapour tends to give a soft and somewhat diffused image. For the same reason a condenser is advisable for commercial work, on account of the sharpness and crispness it gives. This clear, sharp definition is a very important aspect of commercial work, and anything that tends to diffuse the finished enlargement should be avoided.

Practical Considerations. If a vertical type of enlarger is selected for the average commercial studio it must be housed in a room not less than 10 ft. in height. The easel board should be from 2 ft. 6 in. to 3 ft. from the floor to ensure a comfortable working position without unnecessary stooping. It must be erected to ensure absolute rigidity, being bolted to the floor, and if erected in other than a basement it should be bolted to the floor joists to minimize vibration. If, when the enlarger is extended, passing traffic or a person walking across the room causes the least vibration, then means must be taken to secure the lamp-house support to the wall, or a diffused image will result.

It will be advisable, not only on installing, but at intervals to check the parallelism by means of a spirit level to ensure that the lens panel and the paper board or easel are in perfect alinement.

Every care must be taken to prevent any stray light from reaching the sensitized paper during enlargement, particularly when an enlargement of a fair proportion is undertaken and the exposure is longer than normal, as there is a distinct danger of stray light being reflected from the bright metal portion of the apparatus. In such cases, all reflecting surfaces should be temporarily covered with portions of the dull black paper in which the bromide paper is packed.

It is wise to ensure that the dark-room safelight is really safe. This is easily checked by laying a coin on a piece of the sensitized paper normally used and leaving it for about five minutes with the ordinary dark-room safelight switched on. If, after developing, there is any indication of a mark showing where the coin has been placed, you will have a certain indication that your safelight needs attention. Neglect of this simple precaution is the cause of many a degraded print. Proper precautions must also be taken to prevent stray light entering the room when a person enters, and to safeguard against this a light-trap entrance is required, such as indicated in the article on Dark-Room : (1) Planning, page 497. In short, the only light to reach the paper during enlargement should come through the portion of the negative being enlarged, and the edges of any portion of the negative not included in the picture should be masked off by an opaque mask, either by a marking device on the negative holder or on the printing table.

It is occasionally necessary to enlarge from a wet negative or a negative that has been dried hurriedly in spirit. In this event care should be exercised to ascertain that the half-watt illumination is not too hot, as this is likely to cause melting or fading. In an emergency like this mercury vapour is a more suitable illuminant because it gives off practically no heat.

When enlarging from films sandwiched between glasses, using half-watt illumination, care must be taken to see that both film and glasses are bone dry ; otherwise condensation will occur, causing a buckled and damaged film.

It is important to use large-size lenses with a covering power of at least as much as the largest size negative to be enlarged. It has the advantage of enabling the operator to use a larger stop with consequent shorter exposure, and occasions less need for fine adjustment of the illuminant.

Organization. For the production of high quality work in the quickest time the organization of the printing room must be conducted with a high standard of efficiency. Everything in general use must have its appointed place, there must be plenty of space around the enlarging apparatus to permit of the maximum facility for control of the enlarged print. Adequate shelves and bench room must be provided and arrangements made to maintain a standard of absolute cleanliness. All chemicals should be mixed in a separate room ; sinks, splash-boards, benches and shelves should all be so constructed as to enable easy and frequent cleaning. This constant attention to cleanliness will keep the air free from both ordinary and chemical dust, either of which is fatal to good and speedy work.

The Attainment of Quality. The serious worker will take every precaution to ensure that the negatives from which enlargements are to be made are of a uniform standard of quality. Experience will indicate that when a half-watt illuminant and condenser are used a somewhat softer negative than normal will be desirable, as a condenser tends to increase the contrasts of the negative, as well as giving a sharply defined image. It will also be found advisable to grade the negatives in degrees of contrast in order that a batch of negatives can be enlarged on one grade of paper. All negatives should be stored in transparent paper bags, on which appears such details as filing number, customer's name, date, operator, and the grade of paper on which the job has been printed.

When a hard negative has to be enlarged and the softest grade of paper does not give the desired result, an improvement can usually be made by developing in a diluted solution. Similarly, when an enlargement from a specially thin negative on vigorous paper does not give the best result, an improvement can be obtained by using a stronger developer obtained by adding a few drops of 10 per cent. potassium bromide solution.

While it is eminently desirable to secure negatives of a uniform range of densities—and this should be easily possible with the greater proportion of commercial work—there will always be the few specially difficult jobs in which it will be impossible to secure this degree of perfection. In such cases full advantage should be taken of the wide range of sensitized papers on the market. Bromide paper is manufactured in as many as six different degrees of contrast, and provided the right grade is selected and the correct exposure given a good enlargement should be obtainable from negatives of widely differing ranges of contrast ; but it must not be overlooked that the quality of the enlargement depends primarily on the exposure and development of the negative.

Making the Enlargement. To produce work of a consistently high standard demands extreme care, stable conditions and a close attention to the method of working. Solutions should be kept at a constant temperature in the neighbourhood of 65° F. and this particularly applies when using M.Q. developer, which is almost inactive below 60°. Be especially careful not to overwork solutions. An exhausted developer or fixing bath is false economy and bad business practice, for the chemicals used are cheap and any overworking of solutions is bound to cause both dissatisfaction and a demand for fresh prints. It is safe to assume that 20 ounces of M.Q. will develop ten to twelve 10×8 prints, but after this it should be discarded or toned up by the addition of some fresh solution. The developer should be discarded directly it tends to discolour, as this will inevitably cause stained prints.

Preparatory. Before making the actual enlargement there are a few preparations and precautions the careful worker will, as a matter of course, attend to. Before inserting the negative into the enlarger the lens and condenser will be cleaned with soft chamois or an old piece of soft linen, and

examined to see before projecting that both are free from dust and stray matter from the cleaning cloth. If one of the baseboards supplied with the vertical type enlargers is used, the masking arms will be set to give the correct amount of border required. Solutions will have been prepared of the correct strength and temperature, the negatives cleaned, laid out and graded in degrees of contrast, and the sizes and grades of paper will be at hand in light-tight boxes.

Enlarging. We can now proceed to the making of the enlargement. The negative will be placed in the holder, all clear or unwanted portions marked off, and the baseboard or easel will be adjusted to indicate the size of paper to be used and the size of border required. If an enlarger of the automatic type is being used it will be



WITHOUT CONTROL. A straightforward enlargement made from a negative taken with a miniature camera. Compare it with the photograph on the right

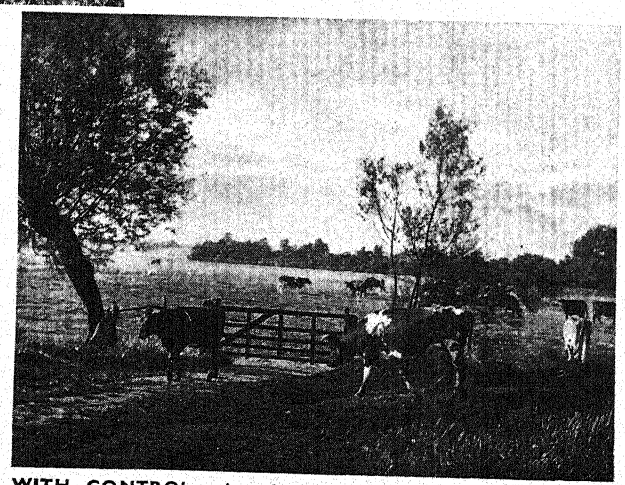
necessary only to move the apparatus up or down to obtain the required size. If the non-automatic type is used, it will be necessary to adjust the focus accurately and again check size, as the fine adjustment for obtaining accurate sharpness will cause a slight alteration in size. This is of special importance in commercial work when enlargements are required of an accurate size for lay-out or make-up purposes. Having secured correct size and absolute sharpness the orange cap will be swung into position, and the worker will—unless making single enlargements of small size and he is very expert—make a test strip exposure.

There are quite a number of factors which influence exposure, such as degree of enlargement, density of negative, lens aperture, grade of paper, the strength of light, etc. Where a number of enlargements are required off a single negative, it is always well worth while to make a test.

Test Strips. The best procedure for ascertaining the correct exposure is first to estimate the exposure required; then make a series of exposures, each twice as long as the one before, such as 5, 10, 20, 40 and 80 seconds, and these will give a comprehensive range which should form an accurate guide to the correct exposure. (*See further under* Bromide Printing page 196.)

Local Control. Experience will indicate that it frequently aids the finished result if manipulation and control are used during exposure. A great deal can be done to hold back portions that are likely to print too dark by manipulating the hands or fingers between the lens and the paper. It is surprising the amount of holding back that can be done with the hands alone. Other methods of local control are given in pages 641 and 658.

Common Faults. Common faults with bromide enlargements are over-exposure and under-development. To ensure



WITH CONTROL. An enlargement made from the same negative In this instance there was control during the projection and the sky was printed in

Photo, Studio Briggs

good, rich blacks it is imperative that the print is developed to finality, which is, of course, only possible when the correct exposure has been given.

If the print has had insufficient exposure the result will be poor and degraded. If, on the other hand, the print has had too much exposure and has been developed fully, the result will be too dark and heavy. If, however, the print is withdrawn from the solution before the development is normally complete in an attempt to save it, it will be flat, with greys instead of blacks.

Manufacturers of sensitized paper each give their recommended formulae, all of which can be relied upon, but in a commercial business it may be found expedient to use more than one make of paper and to keep to a standard developer. In such a case the undermentioned formulae can be used.

Developer for Bromide Papers

M.Q.	Metol	10 grs.
	Sodium sulphite	320 ,,
	Hydroquinone	30 ,,
	Sodium carbonate	320 ,,
	Potassium bromide	10 ,,
	Water to make	20 ozs.

This solution has good keeping qualities if kept in well-corked bottles filled to the neck. It may be used so long as it remains colourless.

Amidol

Sodium sulphite	480 grs.
Potassium bromide	12 ,,
Water to make	20 ozs.
When dissolved add	
Amidol	48 grs.

This solution will not keep in good condition for more than two days.

Development. To develop a print to finality it should remain in the solution from $2\frac{1}{2}$ to 3 minutes.

The exposure made, slide the print under the surface of the developer, taking care to see that the whole print is covered by the solution and is free from air-bells, and by means of tweezers turn the print face downwards and keep the solution moving. The use of paddles ensures that the prints keep immersed during development and fixing, to prevent the print becoming exposed to the air and oxidizing.

Final Control. It is while the print is in the fixing bath that a limited amount of further control can be given. This is done by using a weak solution of ferricyanide. A portion of a print that appears too dark can be lightened by a quick wipe with a piece of cotton-wool saturated with the ferricyanide reducer and immediately immersed again in the fixing bath. In skilful hands, quite a deal of local reducing can be done by applying the reducing solution in small areas by means of a small sable brush.

Ferricyanide Reducer for Local Work on Prints

Potassium ferricyanide	$\frac{1}{2}$ oz.
Hypo	$\frac{1}{2}$,,
Water	10 ozs.

Washing. Proper and adequate washing is not the least important operation in the process of enlarging. If any reasonable degree of permanency is desired for the prints, 20 minutes in a suitable tank or tray should be considered the minimum. Probably the most effective way is by using the cascade type of washer as described in the article on Dark-Room Planning, page 507 (*see also* Washing Negatives and Prints).

A simple method of testing for the presence of hypo is to apply to the edge of the washed print a piece of sodium sulphide, a brownish tinge indicating that hypo is still present.

When an enlargement has to be made of a size larger than the dishes available, and the width of the enlargement is not greater than the longest side of the dish, the difficulty can be overcome by sliding the print through the developer in the deepest dish available, then folding the print, seeing that the solution covers the whole surface. It will be necessary to keep the print on the move, reversing the position frequently during development. Care must be taken to avoid any crack in the surface of the print.

If the prints are to be glazed, it will be necessary to use either a hardening fixing bath or they can be treated with a glazing solution after washing, being careful to avoid over-hardening.

Acid-Hardening Fixing Bath

Hypo	8 ozs.
Potassium metabisulphite	120 grs.
Water to	20 ozs.
Add	
Chrome alum	240 grs.
Water	20 ozs.

Choice of Paper. Reference has previously been made to the type of print required for reproduction. In addition, it should be stated that such work should be made on a white base glossy paper, as buff, toned or matt surface papers increase the difficulties of reproduction. When prints are required for making up or for composite pages, single weight paper should be used.

ENLARGERS & ENLARGING: (3) DAYLIGHT METHODS

While there are certain drawbacks associated with daylight enlarging, it has advantages that make it particularly suitable for amateur work. Here Mr. Bernard Alfieri, Jr., explains what these are and how a daylight projector is operated

Daylight does not offer the convenience of artificial light for enlarging, whilst the variation in the intensity of the light itself makes it difficult to arrive at a given exposure. But when it is realized that many amateurs rely on this method, and some professional photographers choose daylight rather than a more convenient way, there must be a reason worth investigation.

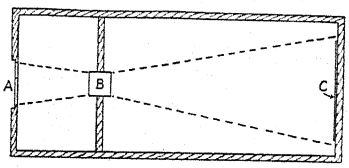
However complicated enlarging apparatus may be, the essential components are a holder for the negative with some means of evenly illuminating it, a lens arranged in a suitable position to project the negative image on to a sheet of sensitive paper and some convenient support to hold the latter. Avoiding the question of convenience, reflected daylight is obviously preferable to artificial light, as it illuminates the negative equally all over with a soft quality of light that requires no previous diffusion. Such an arrangement is free from the accepted drawbacks of a condenser, or of sufficient diffusing screens which are necessary with artificial light in an enlarger of the type that does not employ a condenser, and in this form scratches or abrasions on the negative are reduced to a minimum on the print, whilst handwork and re-touching are not emphasized as would be the case with enlargers employing a condenser.

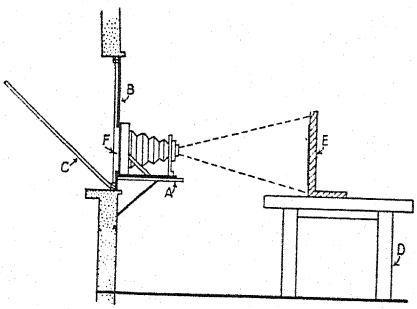
In practice, some lenses are preferable to others for enlarging, but the best enlargements are obtained with a lens of approximately the same focal length as the one with which the negative was taken

With a daylight enlarger one can use the camera itself, and, apart from the length of the exposure and the variation in the lighting, the other conditions are ideal.

Arranging a Daylight Projector. Assuming that a room can be darkened, and the window blocked up with the exception of a small opening the size and shape of the camera, the arrangement is shown in Fig. 2, where a bracket or small shelf (A) supports the camera, whilst the rest of the window (B) is covered. Outside, a white reflector (C), made from any suitable board painted flat white, is hinged at, roughly, an angle of 45 deg. Inside the room a table (D) carries the enlarging easel which will support the bromide paper.

In use the reflector (C) is adjusted until the brightest even lighting is obtained through the camera lens on to the easel. The negative (F) is inserted behind the camera, and the focussing is roughly set by moving the easel, and finally adjusted by means of the camera. Once set, the camera shutter is closed, the bromide paper placed in position and the exposure is made by means of the camera shutter.





Figs. 1 and 2. Lower, diagram showing arrangement of daylight projector. The camera (A) is fixed on a bracket with back to window (B), which is shrouded except where negative (F) is inserted. A reflector (C) is hinged for adjustment, and a table (D) carries the enlarging easel (E). Upper, plan of fixed focus enlarger. A, negative carrier ; B, lens ; C, hinged board

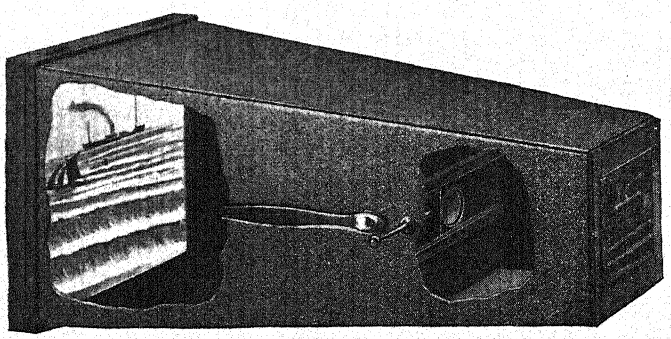
Where very small enlargements are required, and there is not sufficient extension to the focussing arrangements on the camera, it may be necessary to fix the negative in the window opening and, drawing the camera forward to the desired position, cover the intermediate space with cardboard, or make up a rough framework and cover it with a black cloth. The extent of the enlargement will be determined by the distance the easel is away from the camera lens, and once the approximate position of camera and easel has been determined, the focussing movement of the camera can be used for accuracy.

Some cameras are unsuitable for the work, but the camera itself can be replaced by a small box provided with a hole into which the lens can be screwed ; and if the box is

adapted to slide within a second box, one can be withdrawn from the other to provide a means of adjusting the focus. Using a camera that employs dark slides, a simple carrier can be constructed either to slide in place of the dark-slide or, better still, be fixed to the window shutter, which will allow the camera to be moved freely. With a film camera it is necessary to open the back, as for loading film, or obviously the negative will be screened when the camera is placed in position. If the film negative has not been cut it can be wound on a spare spool and placed in the back of the camera, being wound into the correct position and saving the necessity of a film carrier; but this method limits the use of the camera within the focussing extension available.

Given a bright sky, well reflected on to the negative, and a reasonably large aperture lens, the exposure will not be excessive; but if the sky is overcast, reflection poor, or the lens works at a moderately small stop, it may be necessary to give extremely long exposures. So varied are the exposures, not only due to the actinic value of daylight, but also by the efficiency and position of the reflector, that it is impossible to offer any working data; but with small enlargements and favourable working conditions ample exposure may be obtained in a few seconds, whilst at other times, particularly when making very big enlargements from small negatives, an exposure of several hours may be required.

Apart from the delay, there can be little objection, and if a curtain is arranged over the door of the room the camera shutter can be opened and the apparatus left for an hour or two until the exposure is complete.



DAYLIGHT ENLARGING BOX. Simple fixed focus daylight enlarger made by Ensign, Ltd. Cutaway sections show location of bromide paper, achromatic lens and plunger shutter

Fixed Focus Enlargers. Fixed focus daylight enlargers are a convenient means of enlarging to given sizes, such as the whole negative to post-card or whole-plate. There is a variety of box enlargers on the market, covering different sizes of negatives and varying degrees of enlargement, some of them fitted with an exposure device on the outside, where a slow sensitive paper tints until it matches a coloured surround, thus acting as an exposure guide. Where the bromide paper placed within the box is being exposed by projection, the much slower testing paper is being tinted by direct daylight, and the number of " tints " required for any given negative can be readily ascertained and a record kept.

The same procedure can be followed in any form of daylight enlarging by employing a separate actinometer, under constant conditions, when the variation of light can be checked and a record kept for future use.

The usual arrangement is shown in Fig. 1, where a carrier for the negative is shown in the end of a box (A). A panel carrying the lens (B) is fixed in the correct position, to project the image of the negative on to a hinged board (C). The whole device is light-proof.

In use the negative is placed at A, and in the dark-room the hinged end is opened and the bromide or gas-light paper is placed in position at C. The box is now closed and brought out into daylight, the exposure being given either by opening a flap over the negative, or sometimes by sliding out a cap arranged over the lens and connected by a rod to a knob that can be operated from outside. Once this device has been set for any predetermined size of enlargement, it is easy to use and is particularly interesting, as in bright light it can be left for considerable periods and exposure given to slow papers that would be impractical with other types of enlargers. Even with very slow sensitive paper, direct sunshine should never reach the negative. The box may be pointed towards an overcast sky or be exposed from the light of a white reflector.—*BERNARD ALFIERI, JR.*

ENLARGING: (4) PICTURE-MAKING & SELECTION

The possibilities offered by the enlarger of obtaining a selection of effective pictures from a single negative are not realized by many amateur photographers. Here Mr. Emslie Dean describes the methods whereby several groups and scenes are taken from a miniature negative and made into pleasing pictures

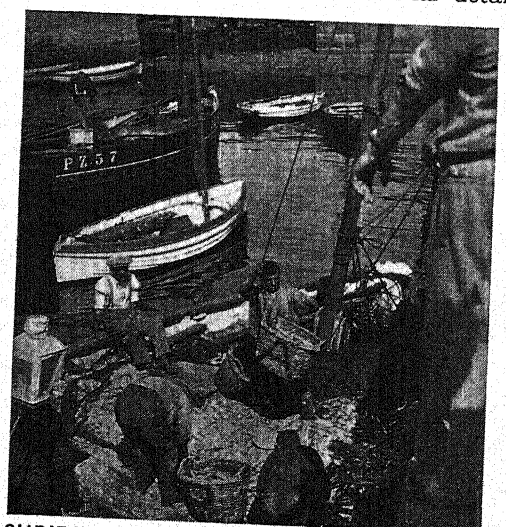
The necessity for enlarging practically every negative taken with a miniature camera has not only introduced the technique of making an enlargement to thousands of new amateurs, but has drawn their attention to the possibilities of the enlarger for picture selecting.

The beginner, however, is never fully aware of the real utility of this, and his tendency, with that of many more advanced workers, is to enlarge the whole of the negative, or, if he realizes that a part is sometimes greater than the whole (pictorially speaking), is never drastic or adventurous enough to explore all the possibilities of the small original to see how many pictures it contains.

Even if he is satisfied that the complete negative does make a good composition without cutting, there are few snapshots of open-air subjects that will not bear trimming and further enlarging to produce several more good compositions. Anyway, it is always worth trying, and it is good fun.

In cases where too much material has been included, and these are in the majority with most amateur miniature shots, the matter adjusts itself by demanding attention.

The print reproduced herewith, showing the complete negative, is a typical instance. It is a good snap of a quayside subject—loading the catch of pilchards. The figure on the right was, needless to say, not observed at the time, and the print obviously includes too much.



SUBJECT IN FULL. In the photograph above the quayside scene depicted contains subsidiary scenes well suited for separation, as shown in the opposite page

For the worker who has not attempted this form of selection the procedure is as follows. First make a good enlargement, say whole-plate or larger, of the complete negative.

When dry, proceed to mask out different parts of the subject to find attractive bits or groups that can be enlarged separately as complete pictures. The easiest way to do this is to employ the old dodge of two L-shaped pieces of thin card, the legs of which are at least as long as the width of the print. One is crossed over the other to form a right-angled frame, the opening of which can be altered to any size or shape by sliding the pieces about (*see* page 647).

Placed on the print and moved all over its surface, various sections of the subject are masked from their surroundings. It becomes a fascinating game to see how many different "bits" are disclosed that can be regarded as pictorial compositions.

In the opposite page are reproduced four out of a dozen made from the subject below, and as the negative was sharp in detail still further enlargements could have been possible even to comparatively large portrait heads of the two fishermen.

The worker with a miniature fitted with a good lens that gives really sharp negatives is for ever surprised at the amount of detail that progressively discloses itself. A moderate enlargement excites interest in the additional details that appear. A still greater enlargement arouses amazement if carried to the limit of the "grainless" stage.

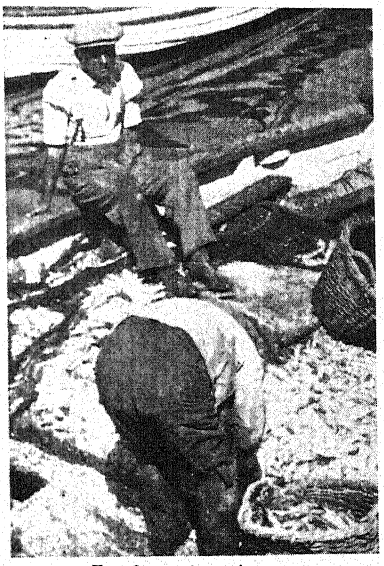
When the "bits" have finally been selected the enlarger is brought into use and that particular rectangle focussed up to the desired size. It is then—if the negative is a good one—that the beauties of the detail secured will be disclosed, and this is one of the minor delights to be derived from miniature photography. The user of

a large camera knows what his negative will give him. The miniature worker is ever in a state of anticipation, and is never quite sure until the enlargement is taken out of the fixing bath what the enlarger has done for him.

Apart from the selection of particular figures, groups, and other bits from a complete shot, the trimming of these portions affords a further exercise for the picture seeker. He will be surprised how many alternative shapes may be employed with the same central figure and yet each produce an attractive composition. An example of this is given in the four pictures shown in this page.

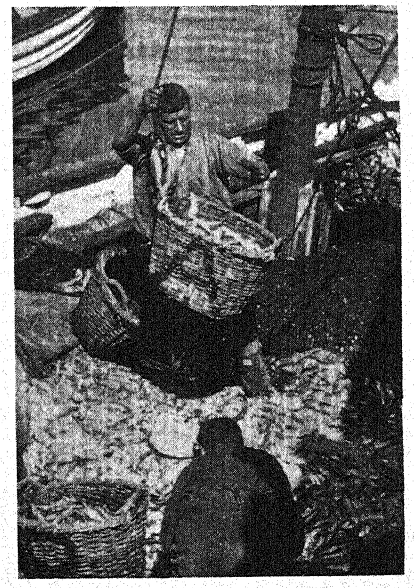


Enlarging the central figure from the main scene

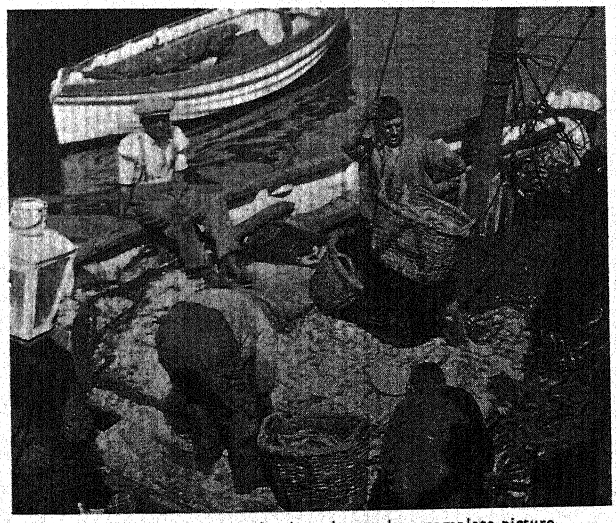


Two figures from the group

When the worker becomes more expert and observant he will find that it is not always necessary to make a print and mask it in the manner described. Provided the negative is not too large and the masking arrangements on the easel of the vertical enlarger are readily adjusted, the choice of subject can be done with the projected negative image only. This will add a still further fascination to making enlargements from miniature negatives, and particularly applies to the 35-mm. strip, which can be run through the enlarger until a likely subject appears on the easel. It can then have the various



A variation of the top picture



The main group cut and enlarged to make a complete picture

maskings adjusted in conjunction with different degrees of enlargement. What at first may appear as an insignificant bit will, on greater enlargement, assume the proportions of an important picture.

In this way many of the negatives taken during the summer may yield more than one picture apiece.—*EMSLIE DEAN*

ENLARGERS & ENLARGING: (5) SHADING CONTROL

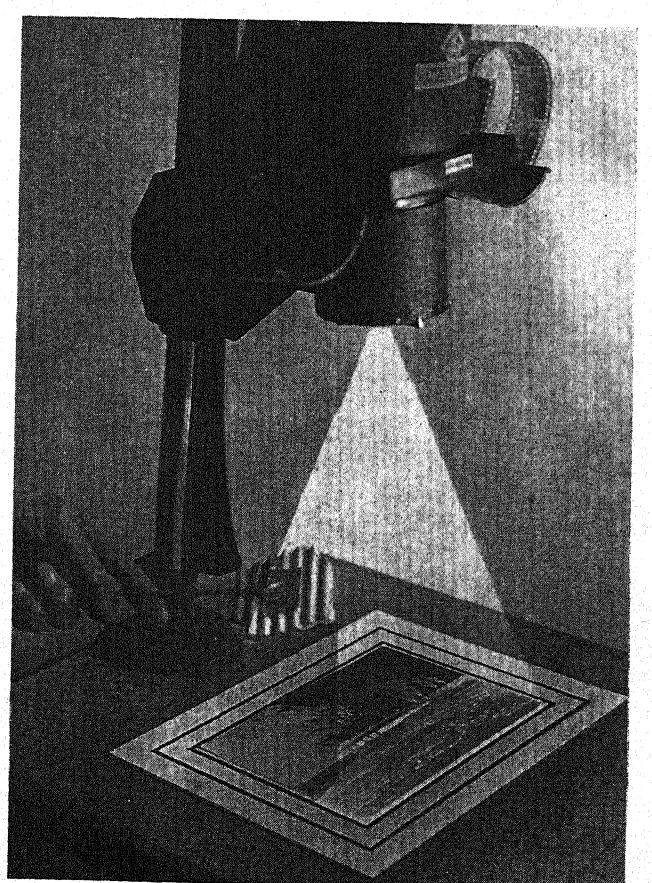
Control of the print in order to obtain satisfactory balance in tone is one of the main factors contributing to success in making distinctive enlargements. How this shading can be done is clearly described by Mr. G. K. Seager in the following article. *See also* Enlarging : (1), page 638

I have met people who appear to think that shading portions of the image in making enlargements is allied to trickery, or that use of the method is a sign of bad workmanship in the making of the negative, and is, therefore, something to be ashamed of. Actually, of course, it is nothing of the sort. The photographer who can translate the tone-scale of his subject, first in the negative and from that to his bromide paper, nicely without any local shading is either very fortunate in the selection of an extremely narrow range of subjects or else he is easily pleased.

The fact is that most of the subjects which make the most attractive pictures have areas of detail which are either extra dense or extra weak in the negative, and which tend either to remain blank or to clog up in enlargements to an extent which is often nothing like so noticeable in the small contact print. Most skilled photographers constantly make use of local shading to get the best results.

There are two distinct varieties of shading. One is represented by using a disk of opaque substance for holding back an area liable to print too heavily. This is represented by a bit of corrugated card stuck on the end of a wire skewer, used to shade the bank of trees in Fig. 1. The other kind consists in the use of a much larger card to hold back the main picture as in Fig. 2, whilst an aperture in it gives extra exposure to a portion. The latter is most usually the sky, but may be a white pavement, a bride's white dress, or the sail of a yacht. The latter illustration, by the way, shows also how a second piece of card may be used to adjust the size or alter the outline of an opening cut in the shading card.

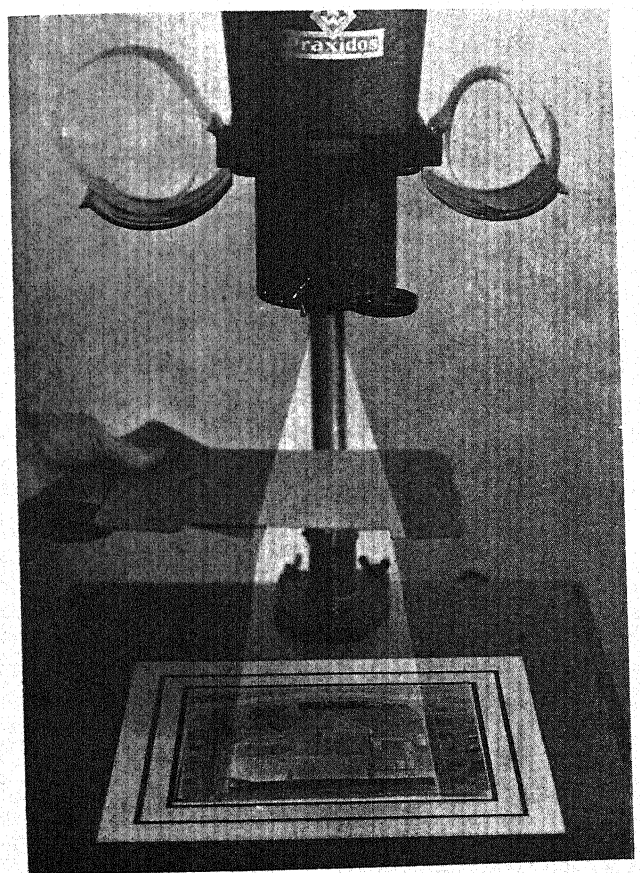
It is rarely practicable to shade, or to print-up, a detail or an area precisely to its outline, and there are wide though not unlimited degrees to which these methods can be used. The shading card should be of about such a size that if it is held somewhere around midway between lens and easel it appears to be casting a shadow of nearly the right size, and it has a fuzzy outline. But one does not rely on this fuzzy outline alone; the shading-tool must be kept gently and steadily moving during the whole time it is in use, thereby blending the parts of the picture which have had more or less exposure respectively without the fact becoming evident. If any difficulty is found in cutting (or, better still, tearing) a card to any required outline, this becomes simple, if a plain card is held in the midway



LOCAL SHADING. **Fig. 1.** A piece of corrugated cardboard fixed to a skewer can be used for shading such subjects as the trees shown here

position described (before putting the bromide paper in position, of course) and the necessary shape sketched upon the projected image on the card. The outline thus marked on the card (by pencil or crayon) can then be followed by scissors.

It is never practicable to use shading with very short exposures, until one becomes really skilled at it. For instance, if a print requires fifteen seconds' exposure, and a deep shadow could do with five seconds less, it takes a good deal of sleight of hand to adjust the shading tool in position and to give it careful, even movement so that its shadow keeps fairly on the right places, and then to switch off the light, all in the space of five seconds. It is much better to stop the lens down, in such a case, so as to have a longer time in which to perform the series of actions without risk of spoiling the result.—*G. K. Seager.*



SHADING WITH A CARD. Fig. 2. The way to hold back the main portion of a picture by interposing a piece of cardboard between the paper and the lens is shown here

ENLARGERS & ENLARGING: (6) CHOICE OF APPARATUS

In the following article Mr. David Charles, F.R.P.S., discusses the advantages, drawbacks and suitability of the two different types of enlarger which are available for the professional worker and the amateur. His review is followed by a detailed description of specific makes of enlargers

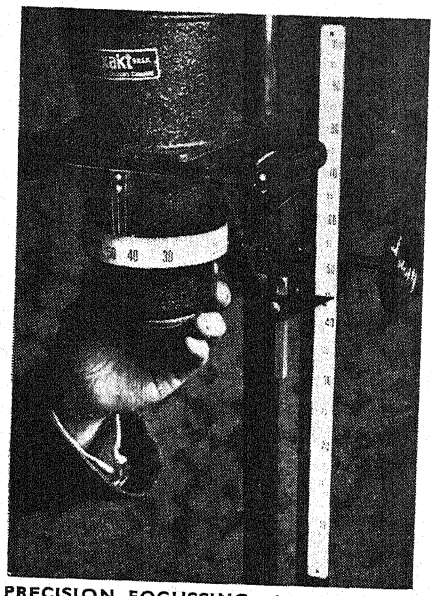
While the choice is less wide than is the case with cameras, many photographers are puzzled at the variety of enlarging apparatus offered. The matter of choice is dealt with in this article with regard to individual requirements.

Main Types. There are two main types into which enlarger may be divided: vertical and horizontal. In the high-speed vertical enlarger the more expensive models are fitted with an automatic focussing arrangement and a large aperture lens.

The projector head slides up and down a vertical pillar, the image being projected downwards on to a large board. This usually carries a paper-holder of some convenient kind, and serves, in addition, as the base upon which the whole enlarger stands.

The horizontal enlarger is built rather like the optical lantern used for the projection of lantern slides. The place of the screen is taken by an easel upon which the paper is pinned. This easel is in most cases structurally separated from the enlarger itself, the two being brought close together for making small prints, and separated more widely for big enlargements.

This is a general description of the two types of enlarger, but it will be understood that there are minor differences between different models of the same type. For example, some models rely on a condenser for even illumination of the negative, while others dispense with this and secure the same end by means of a diffuser. In some instruments the two systems are combined, a collecting lens being used with an opal bulb or other source of diffused light.



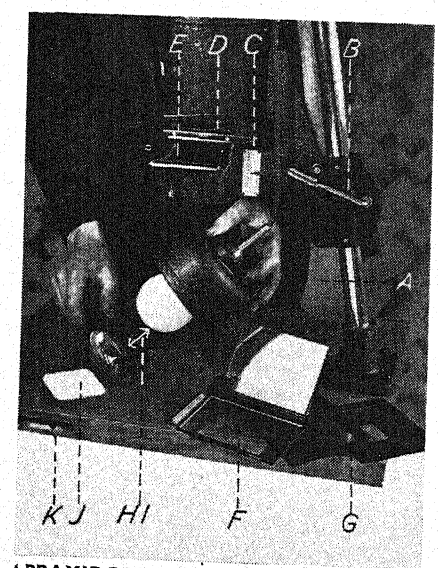
PRECISION FOCUSSING. In the "Exakt" vertical enlarger focussing is carried out by means of the calibrated lens mount. The image is sharp when the numbers on the lens mount and the vertical scale correspond

The Modern Vertical Enlarger. The modern vertical enlarger is built on a substantial baseboard or easel, on which finally the sensitive paper is laid for exposure. From this baseboard rises a pillar on which the projector moves vertically up or down, according to whether a large or a small degree of enlargement is desired.

Automatic Focuss. It is, of course, the nature of the projector itself, and of the means for adjusting it, that concerns the worker most. In the centre of the projector is a removable carrier for the negative. This usually consists of a pair of flawless pieces of glass in a metal frame. In this the negative can usually be given some slight lateral adjustment for centralizing the image without in the slightest degree varying its distance from the lens below. Variation of the lens-negative distance, however microscopic, should be made only by means of the proper adjustment for focussing the easel-image sharply, in accordance with variations in the size of that image produced by moving the projector bodily up or down. In "automatic-focussing" enlargers this focussing adjustment of the lens is done automatically by built-in mechanism, which extends the lens-negative distance as the projector is lowered, and contracts it when the projector is raised for a larger picture. This is done with absolute precision, so that neither the time nor the sight of the photographer is troubled with the matter of focussing.

In using enlargers of the less expensive type, in which automatic focussing is not provided, one first adjusts the image to the size required by moving the projector bodily, and then one obtains sharp focus by a second adjustment to the lens itself, much as in using a camera.

Limitations of Vertical Enlargers. For the great advantage of automatic focussing one has to pay, of course; but there is usually also the additional consideration to be borne in mind that, as a rule, only one particular lens can be used on such an instrument, and that the provision of automatic focussing sets limits to the degree of enlargement available, both of bigness and of smallness.



'PRAXIDOS' ENLARGER. Details of the "Praxidos" automatic-focus enlarger. A, automatic-focussing cam; B, release lever for moving the projector; C, scale showing diameters of enlargement; D, negative-carrier stage; E, wing for ends of negative strip (to obviate cutting separate negatives); F, hinged glass negative-carrier; G, metal masks for 4 x 4 cm. and 35-mm. negatives; H, I, opal lamp and single condenser; J, flashed opal glass, exchangeable with condenser; K exposing switch

If an enlarger is quoted to give, say, ten-diameter enlargements, it will make up to a 15 in. by 9½ in. enlargement of *the whole* of a 35-mm. negative (which is 1½ in. long), or from a similar sized portion of a larger negative. The same enlarger will make still bigger enlargements from still larger negatives, if it is designed to project from larger negatives. But it *cannot* make enlargements *on a bigger scale*, such as the same 15 in. by 9½ in. print from only a part of the miniature negative.

The maximum diameters obtainable on individual enlargers are quoted only by some

makers, and few of them say how *small* a degree of enlargement can be made. Those, therefore, who might want to " blow up " tiny negative images to exhibition sizes are advised to inquire closely before purchasing.

Lighting Systems. The source of lighting employed in nearly all small enlargers today is an opal electric bulb. This, concentrated by a condenser through the negative to the lens, gives a brilliant image with consequent rapid exposures, together with the diffusion which minimizes the reproduction of grain and of surface flaws.

A double condenser projects more light than a single one, and gives possibly more even illumination too ; but requires the lamp to be farther from it, and so calls for a bigger lamp-house. Enlargers which permit of either a single or double condenser usually have provision for adjusting the distance of the lamp from it.

Lenses. Enlargers can be had to use one's existing camera lens. There is no disadvantage, excepting the slight possible inconvenience of changing the lens to and fro. But I would suggest that the camera case is always the better place for *storing* the lens.

Even those whose cameras will not let the lens be unscrewed are catered for by lamp-house constructions to which a camera may be clamped bodily. But as enlarging normally requires greater to-and-fro focussing action than does taking, such instruments must necessarily be limited in range.

Aperture and Speed. Naturally, a big-aperture lens will permit of the shortest exposures, but that is not to say that a lens should always be used at open aperture. Few lenses will project an all-over sharp image when so used, and too short an exposure time gives no latitude for the local shading and printing-up of weak and extra-dense areas which are such a feature of skilled enlarging. It will usually be found that the best performance of an *f*2 lens is somewhere around *f*4.5, and of a lens of *f*4.5 about half-way between *f*8 and *f*11.

Horizontal Enlargers. While the vertical enlarger represents the latest development in enlarger design, there are still many photographers who prefer those of the older type. They are rather lower in cost, and the size of the picture that may be made with an enlarger of this kind is only limited by the dimensions of the dark-room and by the size of the bromide paper.

In addition, these enlargers have sufficient extension of bellows to allow of their being used for reduction. This latter is a valuable feature if lantern slides are being made from quarter-plate or larger negatives. In their best form these enlargers are also provided with a carrier that permits the negative to be displaced from the vertical position. This is useful for the correction of converging vertical lines on the negative.

With the horizontal type of enlarger various forms of illuminant may be employed : electricity, gas, spirit vapour, mercury vapour, limelight, and acetylene. For this reason the horizontal enlarger is the only practical form which can be used in outlying districts not served by an electric supply.

The body of the apparatus is usually constructed of sheet metal. Side and back doors permit of free access to the illuminant.

Between the light chamber and the negative carrier is the condenser (*q.v.*), the function of which is to collect the rays of light from the illuminant and project them through the negative. The condenser of a horizontal enlarger is usually formed of a pair of plano-convex lenses placed with the convex surfaces facing each other and nearly touching. The condenser must be of a diameter slightly larger than the diagonal of the negative from which enlargements are to be made, otherwise the corners of the negative will not be projected on to the easel.

The negative is placed in a carrier which must be as close to the condenser as possible, for if it is separated by more than a very small distance it will not be fully covered and a larger and therefore more expensive condenser will be required. In order that the finished enlargement shall show the image the same way round as the original subject, the negative must be placed upside down and with the emulsion surface towards the lens.

Between the negative carrier and the lens are bellows, the extension of which, carried out by a rack and pinion movement, enables the distance between negative and lens to be varied within the limits of that extension. A variable extension, plus adaptability for various lenses, is helpful because it allows of making lantern-slides and big enlargements within the limited space of a small dark-room.

ENLARGERS: (7) SELECTION OF MODERN TYPES

THE following pages present a review of many of the enlargers available on the British market.

Enlargers are grouped in sizes according to the largest negative each will accommodate. In several cases an enlarger primarily built for 24 × 36 mm. will actually take larger negatives if the need arises. Enlargers for 24 × 36 mm. and 3 × 4 cm. should therefore be sought also under sizes up to 4 × 4 cm., and enlargers for 4.5 × 6 cm. under sizes up to 6 × 6 cm.

For Negatives up to 24 × 36 mm.

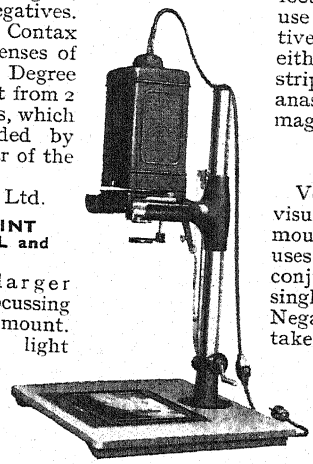
IKOMAT

Vertical enlarger with automatic focussing. For electricity only; uses 75-watt lamp and condenser. Carrier to take 35-mm. film in lengths, or single negatives. Fitted to take Contax or Contaflex lenses of 5-cm. focus. Degree of enlargement from 2 to 10 diameters, which can be exceeded by projecting clear of the baseboard.

Zeiss Ikon, Ltd.

MAGNAPRINT (Models VO/L and VO/C)

Vertical enlarger with manual focussing by helicoidal mount. For electric light only, using 100-watt opal lamp in conjunction with condenser. Baseboard fitted with size-chart and paper clamps.



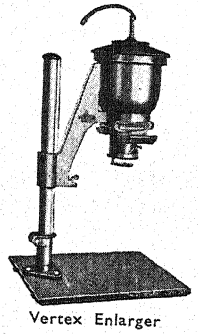
Ikomat Enlarger

Model VO/L takes Leica lenses, and Model VO/C takes Contax lenses. Built to take 24×36 mm. negatives in the roll. Degree of enlargement up to 10 diameters.

Ensign, Ltd.

VERTEX

Vertical enlarger with manual focussing by helical mount. For electricity only; uses 75-watt opal lamp and single condenser. Two types of negative carrier available, both taking 35-mm. film in strips. Takes Leica or Contax lens. With 5-cm. lens enlarges up to 12½ diameters.



Vertex Enlarger

F. Morat & Co., Ltd.

For Negatives up to 3 × 4 cm.

BABY MIRAPHOT

Vertical enlarger with automatic focussing. For electricity only, using gas-filled lamp and condenser. Separate manual focussing arrangements for use when required. Negative carrier takes films, either V.P. or 35 mm. in the strip. Fitted Zeiss Ikon anastigmat. Maximum magnification 8 diameters.

Zeiss Ikon, Ltd.

FILMARUS O

Vertical enlarger with visual focussing by helical mount. For electricity only; uses 100-watt opal lamp in conjunction with single condenser. Negative carrier takes film in the strip as well as separate negatives. Fitted 4.5 cm. double anastigmat *f*6.3, with iris. Range of enlargement from 2 to 8½ diameters.

R. E. Schneider.

FOCOMAT

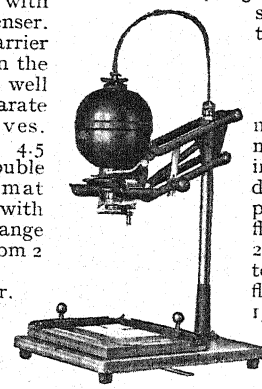
Vertical enlarger with automatic focussing. Uses 75-watt opal lamp and single condenser. Negative carrier designed for 35-mm. film in strips, but film slide for 3×4 cm. can be had. Takes Leica lens, or can be fitted with 5 cm. *f*3.5 lens. Enlarges 2 to 10 diameters, but by projecting off baseboard greater enlargement can be had.

E. Leitz, Ltd.

HELINOX ENLARGING PRINTER

High-grade fixed-focus box form enlarger, fitted *f*6.3 Novar anastigmat and lamp-house containing 40-watt lamp; V.P. film in the strip. Lamp-house detachable for enlarging by daylight. Enlarges to 3½×2½ in. or 4¾×3½ in. according to model.

Zeiss Ikon, Ltd.



Focomat Enlarger

MAGNAPRINT (Model AV/O)

Vertical enlarger with automatic focussing. For electric light only, using 100-watt opal lamp in conjunction with condenser. Baseboard fitted with ruled size-chart and paper clamps. Built for 3×4 cm. negatives, but a special carrier to take 24×36 mm. negatives can be obtained. Degree of enlargement up to 10 diameters.

Ensign, Ltd.

MAGNAPRINT (Models V/O and V/OM)

Vertical enlarger with manual focussing by helicoidal mount. For electric light only, using 100-watt opal lamp, in conjunction with condenser. Baseboard fitted with ruled size-chart and paper clamps. Special carrier for 24 × 36 mm. negatives can be supplied. Enlargement up to 10 diameters.

Ensign, Ltd.

MAGNIPHOT

Vertical enlarger with manual focussing by helical mount. Uses 60-watt lamp in conjunction with condenser, which serves also as pressure plate to hold film flat. Normally fitted with 24 × 36-mm. mask, and to take Contax or Contaflex lens; enlargement 3 to 15 diameters.

Zeiss Ikon, Ltd.

VALOY

Vertical enlarger with visual focussing by helical mount. For electricity only, uses 75-watt opal lamp and single condenser. Negative carrier primarily designed for 35-mm. film in strips, but also with film slide for negatives 3 × 4 cm. Normally takes Leica lens, but 5-cm. *f*3.5 lens can be fitted. With 20-in. upright enlarges 8½ diameters; also 40-in. upright. E. Leitz, Ltd.

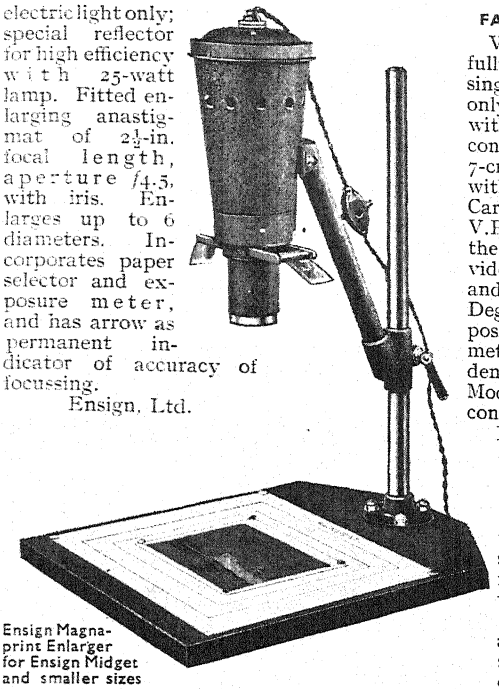
For Negatives up to 4 × 4 cm.

CERTOS

Vertical-type enlarger in which actual projecting-head is horizontal, but image is diverted downwards by a mirror. For

electric light only; special reflector for high efficiency with 25-watt lamp. Fitted enlarging anastigmat of 2½-in. focal length, aperture *f*4.5, with iris. Enlarges up to 6 diameters. Incorporates paper selector and exposure meter, and has arrow as permanent indicator of accuracy of focussing.

Ensign, Ltd.



Ensign Magnaprint Enlarger for Ensign Midget and smaller sizes

CRESCO No. 2

Vertical enlarger with manual focussing operated by quick-thread screw. Electric model uses 100-watt opal lamp in conjunction with condenser; gas model uses bijou inverted mantle in place of opal bulb. Standard negative carrier can be replaced by special hinged carrier taking 35-mm. or V.P. film in uncut lengths for 4s. extra. Degree of enlargement up to 12 diameters when used with a 2-in. lens from Leica or Contax, or up to 8 diameters with 3-in. lens fitted. Form B is for use with purchaser's own lens (fitting extra); Form C has 3-in. lens with iris.

J. Lancaster & Son, Ltd.

EXAKT (Models I and Ia)

Vertical enlarger with semi-automatic focussing by helical mount. Lens-mount and pillar graduated with scales; when these are set to corresponding numbers focussing is correct. For electricity only; uses 40-watt opal lamp with condenser. Choice of several types of negative carriers. Fitted 6-cm. anastigmat, aperture *f*4.5, with iris. Degree of enlargement, Model I, from 2 to 7½ diameters. Model Ia, with longer pillar, enlarges 2½ to 10 diameters. Can be fitted with special interchangeable 3.5-cm. lens for enlarging from negatives up to 18 × 24 mm.

R. F. Hunter, Ltd.

FAM (Models I and II)

Vertical enlarger, fully automatic focussing. For electric light only, using opal lamp with single or double condenser. Fitted with 7-cm. *f*4.5 anastigmat, with iris diaphragm. Carrier takes either V.P. or 35-mm. film in the strip; masks provided for 4 × 4, 3 × 4 and 24 × 36 sizes. Degree of enlargement possible, 2 to 10 diameters. Single condenser in Model I; Model II has double condenser.

R. E. Schneider.

FILMARUS I

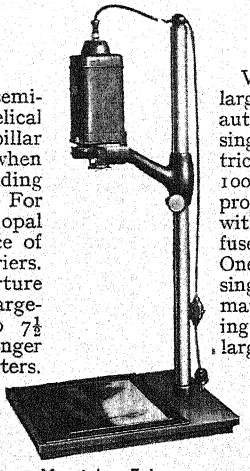
Vertical enlarger with manual focussing by helical mount. For electricity only; uses 100-watt opal lamp and single condenser. Negative carrier takes film in the strip as well as single negatives. Fitted 5.5-cm. double anastigmat *f*4.5 with iris. Range of enlargement from 2 to 10 diameters.

R. E. Schneider.

FOTH

Vertical enlarger with manual focussing by helical mount. For electricity only; uses 100-watt opal lamp in conjunction with single condenser. Negative holder has adjustment for masking all negatives up to 4 × 4 cm. Fitted Foth *f*3.5 lens, with iris diaphragm. Maximum enlargement 7 diameters.

Peeling & Van Neck, Ltd.



Magniphot Enlarger

PRAXIDOS

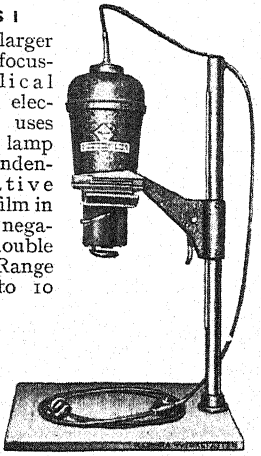
Vertical enlarger with fully automatic focussing. For electricity only, using 100-watt opal or projection lamp with either diffuser or condenser. One-hand focussing. Scale automatically indicating degree of enlargement from 2 to 10 diameters. Negative carrier takes film in the strip, and can be fitted with interchangeable masks in any standard size from 24 × 36 mm. to 4 × 4 cm. Fitted with 5.5-cm. anastigmat *f*3.5, with iris, or can be had fitted to take Leica or Contax lenses.

Sands Hunter, Ltd.

PRAXIDOS O

Vertical enlarger with manual focussing by helical mount. For electricity only, using opal or projection lamp, with either opal glass diffuser or condenser. Automatic lever locking projector-head at desired height. Negative carrier and mask of any standard size up to 4 × 4 cm. can be had with the enlarger. Fitted with *f*4.5 6-cm. lens, with iris. Degree of enlargement, 1.6 to 8 diameters.

Sands Hunter, Ltd.



Praxidos Enlarger

RAJAH (Model O)

Vertical enlarger with manual focussing by helical mount. For electricity only, using opal lamp in conjunction with single condenser. Universal negative carrier allows for use of single negatives or film in the roll. Masks for 4 × 4, 3 × 4 and 24 × 36 negatives. Fitted with *f*4.5 6-cm. lens. Enlargement 2 to 8 diameters. Norse Trading Co., Ltd.

For Negatives up to 6.5 × 4 cm.

DAORNYTA

Fixed-focus box-form enlarger, without lamphouse, making prints 5½ × 3½ in. from 4 × 6.5 cm. negatives. Opal diffusing screen over negative allows use of artificial light when required. Achromatic lens with shutter. Price complete, £1 1s.

J. Lancaster & Son, Ltd.

HORIZONTAL MAGNAPRINT (Model H/O)

Simple horizontal enlarger with manual focussing by helicoidal mount. For electric light only, using 100-watt opal lamp in conjunction with 3-in. condenser.

Ensign, Ltd.

EXAKTA

Simple vertical enlarger, with manual focussing, for use with

lens from Exakta camera. Can also be used horizontally if desired. For electric light only, using diffusing system. Lamphouse of wood, enamelled white inside and with outside covered with leatherette. Carrier takes negatives in the strip. Enlarges up to 6½ diameters.

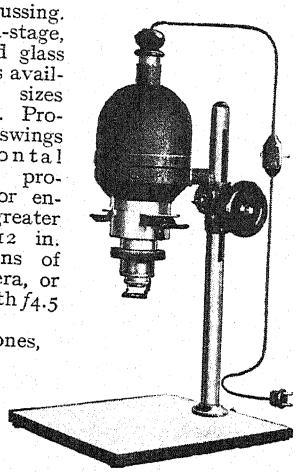
Garner & Jones, Ltd.

For Negatives up to 6 × 6 cm.

DUPLEX LUMIMAX

Vertical enlarger combined with projector. For electricity only; uses 100-watt opal lamp and double condenser. Manual focussing. Spring film-stage, with bevelled glass plate; masks available for all sizes to 6×6 cm. Projector-head swings into horizontal position for projecting, or for enlargements greater than 12 × 12 in. Will take lens of Exakta camera, or can be had with *f*4.5 lens.

Garner & Jones, Ltd.



Duplex Lumimax Enlarger

EXAKT (Models II and IIa)

Vertical enlarger and semi-automatic focussing by helical mount. Lens mount and pillar graduated with scales; when these are set at corresponding numbers image is sharp. Can be fitted for interchangeable lens of 6-cm. focus for enlarging from negatives up to 4×4 cm. For electricity only; uses 60 to 100-watt opal lamp with condenser. Choice of several types of negative carrier. Fitted 9 cm. 4.5 lens, with iris. Degree of enlargement from 2.7 to 8 diameters in Model II; with Model IIa, with higher upright, range is 2½ to 10 diameters.

R. F. Hunter, Ltd.

FAM (Models III and IV)

Vertical enlarger, fully automatic focussing. For electricity only, using opal lamp in conjunction with diffuser in Model III, and condenser in Model IV. Carrier takes film in the strip as well as separate negatives. Fitted 10.3 cm. *f*4.5 lens, with iris, and set of masks for all standard sizes up to 6×6 cm. Enlargement possible, 1½ to 10 diameters. R. E. Schneider.

FILMAREX O

Vertical enlarger with manual focussing by helical mount. For electricity only; uses 100-watt opal lamp and single condenser. Negative carrier takes film in the strip as well as single negatives. Fitted 9-cm. double anastigmat *f*4.5, with iris; range of enlargement from 1½ to 10 diameters.

R. E. Schneider.

LUMIMAX

Can be used vertically or horizontally, with manual focussing by helical mount. For electricity only. Wooden body, white inside and leatherette outside. Can be had fitted for lens from Exakta camera or with 7-cm. *f*4.5 lens and 3-in. condenser.

Garner & Jones, Ltd.

MAGNAPRINT (Models V/10 and V10M)

Vertical enlarger with manual focussing by helicoidal mount. For electric light only, using 100-watt opal lamp in conjunction with condenser. Baseboard fitted with ruled size-chart and paper clamps. Carrier provided with masks for sizes smaller than 6 × 6 cm. Degree of enlargement from 1½ to 6½ diameters.

Ensign, Ltd.

PRAXIDOS

Vertical enlarger with fully automatic focussing. For electricity only, using 100-watt opal or projection lamp, in conjunction either with condenser or diffuser. Scale showing degree of enlargement from 1½ to 7½ diameters. Negative carrier takes film in the strip, and can be had fitted with interchangeable masks for all sizes up to 6 × 6 cm. Fitted 7.5 cm. anastigmat *f*3.5, with iris.

Sands Hunter, Ltd.

PRAXIDOS O

Vertical enlarger with visual focussing by helical mount. For electricity only, using opal or projection lamp, with diffuser or condenser. Automatic lever locking projector-head at required height. Negative carrier takes interchangeable masks of all standard sizes from 24×36 mm. upwards. Fitted 7.5-cm. *f*4.5 lens, with iris. Enlargement, 1.6 to 6 diameters. Sands Hunter, Ltd.

RAJAH (Model I)

Vertical enlarger with manual focussing by helical mount. For electricity only, using opal lamp and double condenser. Universal negative carrier taking negatives singly or in strips. Fitted *f*4.5 enlarging anastigmat. Degree of enlargement up to 6 diameters.

Norse Trading Co., Ltd.

VERTEX

Vertical enlarger with manual focussing by helical mount. For electricity only; uses 100-watt opal lamp and single condenser. Two types of negative carrier available, either of which takes film in the strip, Choice of four lenses, two of which have iris. Degree of enlargement up to 6¾ diameters.

F. Morat & Co., Ltd.

For Negatives up to 3½ × 2½ in.

NON-AUTOMATIC MODELS

AMPLUS No. 2

A vertical enlarger with manual focussing, for either electricity or incandescent gas. Can be obtained complete with lens, to take user's lens, or without focussing arrangement to take user's camera and lens. With 4-in. lens enlarges from 1½ to 5 diameters, greater enlargement being obtainable by projecting off baseboard.

J. Lancaster & Son, Ltd.

AMPLUS No. 4

Vertical enlarger for electricity or incandescent gas. Fitted double condenser and optional diffuser. Semi-automatic focussing by scales on pillar and focussing. Supplied complete with lens, to take user's lens, or to take user's lens and camera. With standard 4-in. lens reduces to half-size or enlarges to 6 diameters; with 3-in. lens enlarges to 9 diameters. Greater enlargement by removing paper board and projecting through base.

J. Lancaster & Son, Ltd.

DIFFUSA V.M.

Simple vertical enlarger consisting of Diffusa H.M. mounted on vertical pillar which clamps to table. With 4-in. lens enlarges 1½ to 4 diameters, or more if arranged to project image off table.

J. Lancaster & Son, Ltd.

FILMAREX (Model III)

Vertical enlarger with manual focussing, over a range of enlargement from 1½ to 7 diameters. Greater enlargement can be obtained by swinging the lamphouse round on the upright. Fitted for electricity only, using a 100-watt pearl lamp in conjunction with diffuser. Fitted 10.5-cm. *f*4.5 double anastigmat with iris.

Baseboard takes paper up to 20 × 15. Can be fitted with interchangeable lens giving enlargement to 13½ diameters from 4 × 4 cm. negatives.

R. E. Schneider.

LUMIMAX

Vertical enlarger with manual focussing by rack and pinion. For electricity only, using either condenser or diffuser. Fitted with 10.5-cm. *f*4.5 Ihagee anastigmat, which has a fixed stop for *f*6.3. Will enlarge from 1½ to 4 diameters, but lamp-house can be turned round to project off baseboard where greater enlargement is required. Garner & Jones, Ltd.

MAGNAPRINT V/II

Vertical enlarger with manual focussing by helical mount. For electricity only, using double condenser and 100-watt opal lamp. Fitted with *f*6.3 or *f*4.5 anastigmat, it enlarges from 1.3 to 5½ diameters. This range can be extended by projecting off the baseboard, which will take paper up to 15 × 12 in. Ensign, Ltd.

PERFECTA

Vertical enlarger with focussing by rack and pinion. For electricity only, using 4½-in. double condenser. Fitted with 4-in. *f*4.5 Dallmeyer anastigmat. Enlarging from the same size to 4 times. Can be fitted if preferred with 3½-in. lens giving enlargement to 5¼ times.

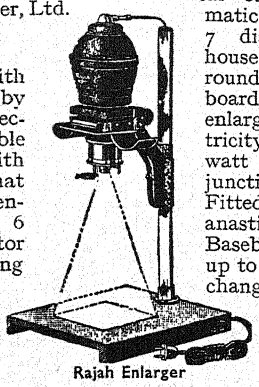
Thornton-Pickard Co., Ltd.

PRAXIDOS (NEW MODEL)

Vertical enlarger with manual focussing, using 100-watt opal lamp in conjunction with diffuser, or a projection lamp with a condenser. Fitted with interchangeable 10.5-cm. *f*4.5 anastigmat with iris diaphragm. Enlarges 1.6 to 7 diameters. Projector head can be swung clear of the baseboard for greater enlargement. Baseboard will take paper up to 20 × 16. Sands Hunter, Ltd.

RAJAH

Vertical enlarger with manual focussing by helical mount. For electricity only, using double condenser fitted with 90-mm. *f*4.5 anastigmat without iris, giving enlargement from 2 to 6 diameters. The projector head can be swung round for greater enlargement. Baseboard will take paper to 20 × 16 in. Norse Trading Co., Ltd.



Rajah Enlarger

VYBOO

A vertical enlarger with manual focussing. For electricity only, using either double condenser or completely diffused light as desired. Fitted 9.5-cm. *f*4 anastigmat with iris. Range of enlargement from 1½ to 6 diameters. Can be fitted with 5-cm. lens for miniature negatives, when the range of enlargement becomes from 1½ to 13 diameters. Baseboard will take paper up to 20 × 16 in.

E. Leitz, Ltd.

AUTOMATIC MODELS

AUTO-AMPLUS No. 1

Vertical enlarger with automatic focussing for enlargements from 1½ to 4 diameters. For electricity only, using two lamps, reflector, and diffuser. Supplied with 4-in. anastigmat with sliding stop for *f*11, or with iris at an extra charge. Baseboard will take paper to 15 × 12 in.

J. Lancaster & Son, Ltd.

AUTO-AMPLUS No. 6

Vertical enlarger with automatic focussing, fitted for electricity or incandescent gas in conjunction with double condenser. Alternative diffusing arrangements are included. Can be obtained without lens, or with 4-in. lens giving enlargements to 9 diameters, or reductions to half-size. With 3-in. lens it enlarges to 13 diameters.

J. Lancaster & Son, Ltd.

EXAKT (MODEL III)

Vertical enlarger with semi-automatic focussing. Uses opal lamp with double condenser. Normally fitted with 10.5-cm. *f*4.5 anastigmat without iris diaphragm. Enlarges 1.7 to 6.3 diameters. Baseboard will take paper up to 20 × 16 in. Can be fitted with 6-cm. lens interchangeable, with standard for enlargement 4½ to 13 diameters from negatives up to 4 × 4 cm. R. F. Hunter, Ltd.

FAM MODEL V

Vertical enlarger with automatic focussing; 1½ to 7 diameters ; lamp-house can be swung round to project off baseboard for still greater enlargement. For electricity only, using 100-watt pearl lamp in conjunction with diffuser. Fitted 10.5-cm. *f*4.5 anastigmat with iris. Baseboard will take paper up to 20 × 15 in. Interchangeable lenses for greater enlargement from smaller negatives can be fitted.

R. E. Schneider.

FOCOMAT MODEL II

Vertical enlarger with fully automatic focussing. For electricity only, using double condenser. Fitted 9.5-cm. *f*4 anastigmat with iris. Range of enlargement from 1.8 to 6 diameters, this range being increased to 9 diameters by using manual focussing.

Lenses of shorter focal length can be fitted for use with negatives up to 4 × 4 cm. This gives enlargement from 2 to 15 diameters with automatic focussing, and up to 18 diameters with manual focussing.

E. Leitz, Ltd.

MIRAPHOT

Vertical enlarger with automatic focussing. For electricity only, using special lamp with reflector and diffuser. Fitted with *f*6.3 Novar or *f*4.5 Tessar lens. Enlarges from 1½ to 3½ diameters. Lamp-house cannot be swung round for greater enlargement.

Zeiss Ikon, Ltd.

MAGNAPRINT AV/II

Vertical enlarger with automatic focussing. For electricity only, using 100-watt opal lamp and double condenser. Fitted 4-in. *f*4.5 Dallmeyer anastigmat. Enlarges from 1.3 to 5½ diameters. Lamp-house cannot be swung for projecting off baseboard, which takes paper up to 15 × 12 in.

Ensign, Ltd.

AUTOMATIC PRAXIDOS

Vertical enlarger with automatic focussing, giving a range of enlargement from 1½ to 7 diameters. Fitted with an 11.5-cm. *f*3.5 anastigmat, with iris diaphragm in interchangeable mount. For electricity only, using 100-watt opal lamp with diffuser, but can be fitted with a condenser if preferred.

An interchangeable lens for obtaining enlargement up 12 diameters from 24 × 36 mm. negatives can be fitted.

The baseboard takes paper up to 20 × 16 in.

Sands Hunter, Ltd.

VERTEX AUTOMATIC

Vertical enlarger with fully automatic focussing. For electricity only, using either diffuser or condenser.

Model 331 has 10.5-cm. *f*4.5 three-component anastigmat, Model 333 has *f*3.5 four-component anastigmat with iris diaphragm. Range of enlargement from 1½ to 6 diameters. Baseboard will take paper up to 15 × 12 in.

Actina, Ltd.

ENLARGERS & ENLARGING: (8) HOME-MADE LANTERN

S. G. Blaxland Stubbs

In the following article working instructions are given to assist the practical photographer in the construction of a horizontal enlarger that is both efficient and low in cost. Embodying the use of the amateur's camera for projection, it requires little in the way of special materials and fittings, and the entire apparatus can be made with ordinary tools and in a short time

A HOME MADE enlarging lantern using a condensing lens, with the amateur's camera for projection, and having all the movements and adjustments of an expensive, professionally-made lantern, can be made by the amateur for the cost of a condensing lens and a couple of shillings. Such a lantern, made by the writer, is shown in the photograph (Fig. 1). If required there is, of course, no difficulty in adapting the design for construction in more solid and heavier materials at some extra expense. The body seen in Fig. 2 could, for instance, be made in oak-faced plywood or mahogany.

The body consists of 3-ply wood taken from a tea-chest, the dimensions of which are shown in the sectional diagram (Fig. 2). It is built up on a stout baseboard, 16 in. long, $7\frac{1}{4}$ in. wide, and $\frac{3}{4}$ in. thick (Fig. 3). The baseboard must be flat and rigid and not liable to warping by heat. Mahogany or braced (cross-battened) oak, $\frac{3}{8}$ in. thick, may be used.

To this baseboard the two sides of the box which constitutes the lantern are screwed. They are 2 in. shorter than the baseboard ; a removable end piece, A, carries a black velvet curtain to cover the end of the box and prevent light leaking out. The end piece fits loosely to permit the withdrawal of the lamp house and its fittings. Its dimensions are seen in Fig. 2 ; the two sides are screwed at the top to a piece of wood $7\frac{1}{4}$ in. long, $2\frac{1}{2}$ in. wide, and about $\frac{3}{8}$ in. thick, and braced at the bottom by a piece $7\frac{1}{4}$ in. by $\frac{3}{8}$ in. by $\frac{1}{4}$ in. It is shown partly withdrawn in Fig. 1.

Lantern Body. The box has practically no top. At the front a cover, B, about $3\frac{1}{2}$ in. or 4 in. deep, is provided (Fig. 2). Along the top of both sides strips of tin, C, $12\frac{1}{2}$ in. long, $1\frac{5}{8}$ in. wide, bent along their length at right angles, are nailed or screwed. These angle strips are bent so that one side is at least 1 in. wide, the other being $\frac{3}{8}$ in. or less, and this wider side is painted underneath with dull black in order to reduce light reflection. On the baseboard are fitted the tubes and sliding platform for the lamp-house. Dimensions are given in Fig 3. The long tubes are fastened at each end to blocks of wood by straps of tin bent over and screwed to the blocks. The latter are kept in position by nails or brads round them (not through them) knocked into the baseboard. They are thus independent of the baseboard, and the whole of this portion is easily removed from the lantern, as seen in Fig. 4. On the long tubes are placed two shorter pieces of slightly larger tubing, which slide freely and are connected by a stout plate of copper or other metal, soldered at each end. A slot is cut in the centre. Pieces of an old tubular brass camera tripod serve this purpose, or brass curtain rods or tubing of two sizes can be used, provided they are of substantial brass, and not merely rods covered with thin brass sheeting.

The Lamp House. On the centre plate the lamp-house proper is fixed ; it consists essentially of a cigar box with an adjustable lamp carrier as seen in the photograph in Fig. 4. It is fastened to the plate by a bolt and nut, which passes through the slot on the plate (Fig. 3), thus permitting a sideways movement of the lamp house to allow for the adjustment of the light. Backward and forward movement is supplied by the sliding tubes on which the plate is supported ; upward and downward movement by the adjustable lamp carrier.

In the case of the lantern described, an old focussing projection piece from a disused magic lantern was made use of, the lenses having been removed. Such pieces of scrap optical apparatus can be easily picked up from optical dealers or on second-hand stalls.

An alternative arrangement for raising and lowering the light is shown in Fig. 5, where an ordinary electric bell or wireless terminal, A, slides up and down a rod, the flex of the

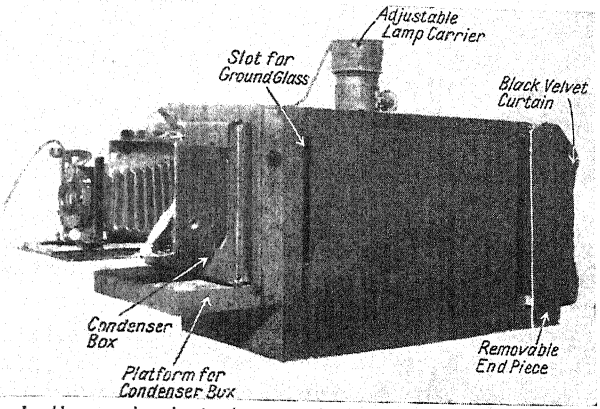


Fig. 1. Home-made enlarging lantern with condenser using electric light and the amateur's camera

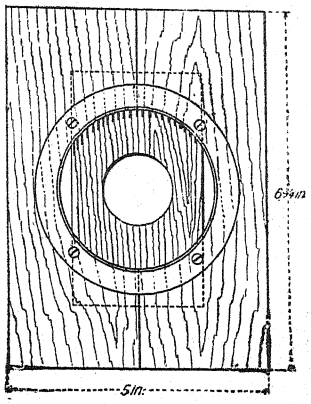


Fig. 6. Top cover for lamp-house and base for lamp carrier

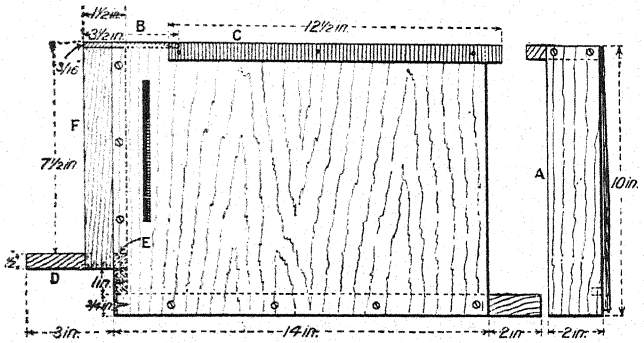


Fig. 2. Sectional diagram of body of lantern made of 3-ply wood

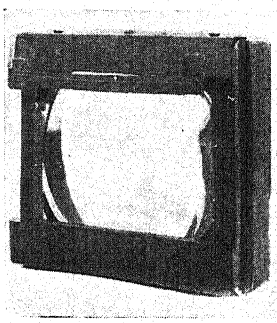


Fig. 7. Condenser box made from biscuit tin, showing arrangements for holding negative carrier and camera

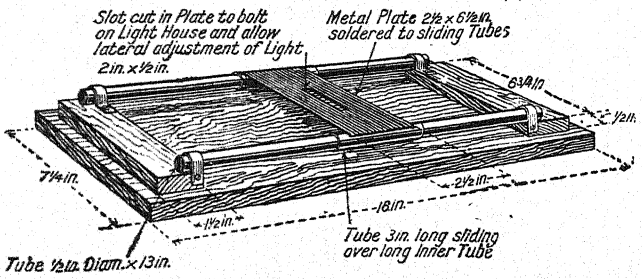


Fig. 3. Baseboard and sliding platform for lamp-house

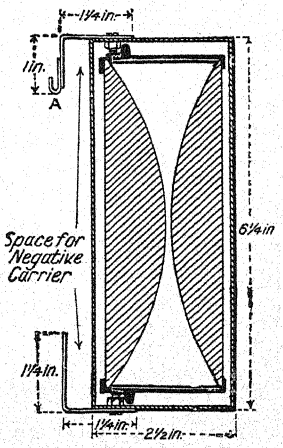


Fig. 8. Sectional diagram for construction of condenser box

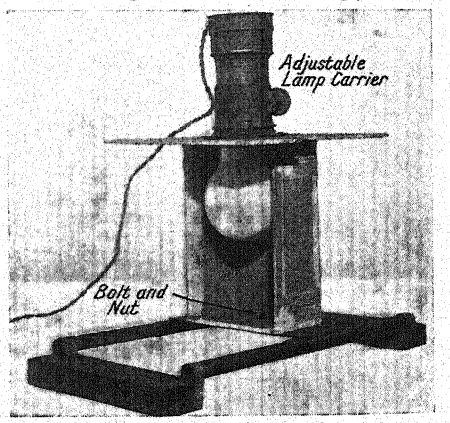


Fig. 4. Lamp-house and adjustable carrier

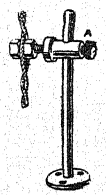


Fig. 5. Alternative lamp holder for use with electric light

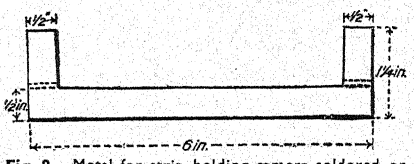


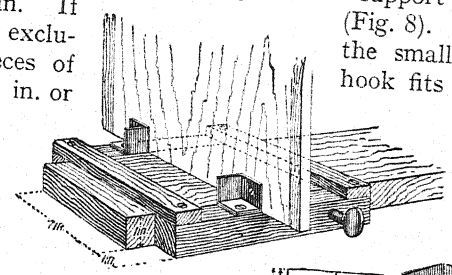
Fig. 9. Metal for strip holding camera soldered on front of condenser box

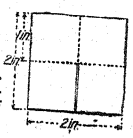
ENLARGING. Figs. 1-9. HOME-MADE ENLARGING LANTERN WITH CONDENSER

electric lamp being gripped, not too tightly, between two nuts on the shank of the terminal. Other forms of light holders can be improvised on similar lines, suited to the particular form of lighting employed.

The lamp-house is completed by two pieces of wood in the dimensions shown in Fig. 6, screwed on to the top of the cigar box with a circular hole cut in the centre to allow the body of the focussing piece, which is used as the lamp carrier, to pass through.

The purpose of these pieces is to provide a covering for the light when in the lantern. The covering moves with the light, and prevents direct rays escaping from the lantern, since it moves underneath the overlapping strips of blackened tin. If further means of light exclusion are required, pieces of 3-ply wood $7\frac{1}{2}$ in. by 3 in. or 4 in. can be placed on top of the box at either end, according to the position of the lamp-house. At the front end of the lantern a slot is cut with a keyhole saw to take a frame holding a sheet of ground glass for diffusion of light, if necessary. The slot is cut at the height of the condenser, and a strip of wood is fastened inside to provide a ledge for the diffusing glass.





HOME-MADE ENLARGER. **Fig. 10.** Details of construction of easel with method of attachment to sliding saddle

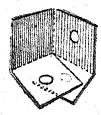


Fig. 11

The complete arrangement of the lamp-house is shown in Fig. 4 (p. 667). It will be seen that it provides adjustment in every direction for accurate centring and focussing of the light. Such adjustment is particularly necessary when a filament lamp is used, where the effective light source is a point of light. In the photograph a lamp with an opaline bulb is shown. In this kind of lamp the light is diffused fairly equally all over the surface of the bulb, and reduces the need for such close and accurate adjustment. A pearl bulb is not so effective but can be used.

The condenser box is seen in the photograph (Fig. 7) and the diagram (Fig. 8). For a $5\frac{1}{2}$-in. condenser, such as is necessary for enlarging quarter-plate negatives, a biscuit tin $6\frac{1}{4}$ in. square and about $2\frac{1}{2}$ in. deep is required, or a larger one can be cut down to fit, the cut ends being turned over and soldered. An aperture is cut in the bottom of the tin $4\frac{1}{2}$ in. wide and $3\frac{3}{8}$ in. deep, *i.e.* a little larger than a quarter-plate. A strip of copper the length of the condenser box and $2\frac{1}{4}$ in. wide is taken and bent over at right angles, one side of the bend being $1\frac{1}{4}$ in. wide, the other 1 in. A second strip of the same length $2\frac{1}{2}$ in. wide is bent over at right angles, each bend in this case being $1\frac{1}{4}$ in. wide. These strips are bolted on to the top and bottom of the condenser box to allow the negative carrier to be pushed in between the strips and the box, gripping it but permitting free movement. On the copper strip which is bolted on to the top of the condenser box a hooked piece is soldered on to support the camera, as shown at A (Fig. 8). Its dimensions are given in the smaller diagram (Fig. 9). This hook fits into the slot at the back of the camera in which the focussing screen slides. The condenser is wedged into the tin box with pieces of wood cut to fit.

The condenser box is made a light-tight fit in the front of the lantern in the manner shown in the photo (Fig. 1) and in the diagram (Fig. 2). A solid piece of wood, D, about $\frac{1}{2}$ in. thick and $6\frac{3}{4}$ in. wide, supplies a platform for the condenser box. It is screwed on to an upright piece, E, $7\frac{1}{4}$ in. by 1 in. by $\frac{1}{2}$ in. On both sides uprights, F, of $\frac{1}{4}$ in. 3-ply wood are screwed, with a cross-piece at the top, of the depth required to make the condenser box a reasonably tight fit. When the condenser box is in position light leakages are stopped by stuffing strips of black cloth all round; these are nailed down with narrow strips of 3-ply wood.

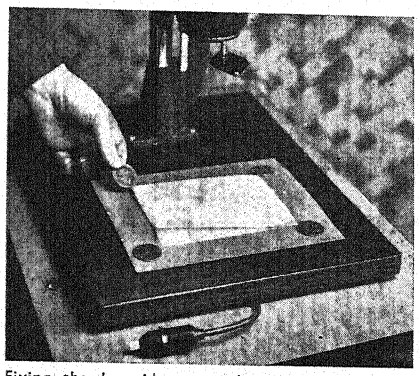
So that there shall be no need to move the lantern backwards and forwards in enlarging different sizes, the easel is arranged to slide along the plank. Details of its construction are seen in Fig. 10. The easel consists of an ordinary large-sized drawing board fastened to a sliding saddle-piece by means of two copper brackets, which are cut out of a piece of 2 in. square metal and folded up as shown dotted in Fig. 11. A thumbscrew passes through the saddle, gripping the edge of the plank to keep the easel fixed in position.

ENLARGERS & ENLARGING: (9) SIMPLE AIDS

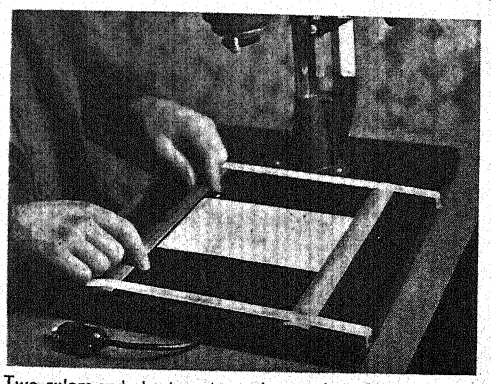
In this highly practical series of articles associated with enlarging work a number of carefully selected hints and tips by various people are presented to help the amateur worker. By exercising a little ingenuity, improved results can be obtained and common difficulties overcome. A further article which deals with enlarging from cine frames completes this series devoted to enlargement

WHILST many people like the white margins to their enlargements which the commercial composing-frame produces, others prefer to use the maximum area of their bromide paper, afterwards trimming off only the barest edges. In order to achieve this satisfactorily it is necessary to have some means of registering the bromide paper accurately with the desired part of the image, and then of securing it in place. Here are two very simple methods of doing this :

The first one comprises having a piece of white paper, the same size as the bromide paper to be used, stuck flatly on a larger piece of thin card. One of these can be made in a few minutes for each stock size used. The picture is composed on the white area, which can be moved about as required to get slanting horizons level, and so on. Then the light is switched off and the sensitive paper can be laid with perfect confidence just to cover the white focussing space and can be held in place by means of four pennies. A penny at each corner will weight the paper satisfactorily while obscuring only the minutest edge of it. The apparatus is shown in the illustration below.



Fixing the bromide paper by coins disposed at each corner



Two rulers and elastic strips make an adjustable paper grip

The second method is to buy a yard of half-inch wide elastic and two rulers. The elastic is cut in halves and is stretched across the easel, where it can be fixed with drawing-pins. It then forms a pair of springs which hold the rulers quite firmly, while allowing them to be freely slid about or lifted as desired. In using this method it is not necessary to mount the focussing sheet at all. When the view has been satisfactorily arranged on its surface, it is just clipped by the rulers, as shown in the illustration below, left, and the bromide paper is then laid on it and is held in the same way.—*D. CHARLES.*

White Borders for Bromide Enlargements. Fixing bromide paper to the easel of a horizontal enlarger is a tedious job, and to ensure a uniform white border is difficult, but, with the simple frame shown in page 670, it can be made quite an easy matter.

The frame is made from stiff card with a clean rectangular hole cut to the size it is desired to use, less about $\frac{1}{8}$ in. all round to form the white border. The edges of the card frame should be 2 to 3 in. wide, to give a fair amount of rigidity. A piece of stout smooth paper is then stuck on to the back to adhere to within $\frac{1}{8}$ in. of the bottom edge of the opening, but sufficiently wide to cover about a quarter of the aperture itself. The width of the paper holder should also be wider than the aperture, as seen on sketch of the back view, making a kind of pocket for the bromide paper.

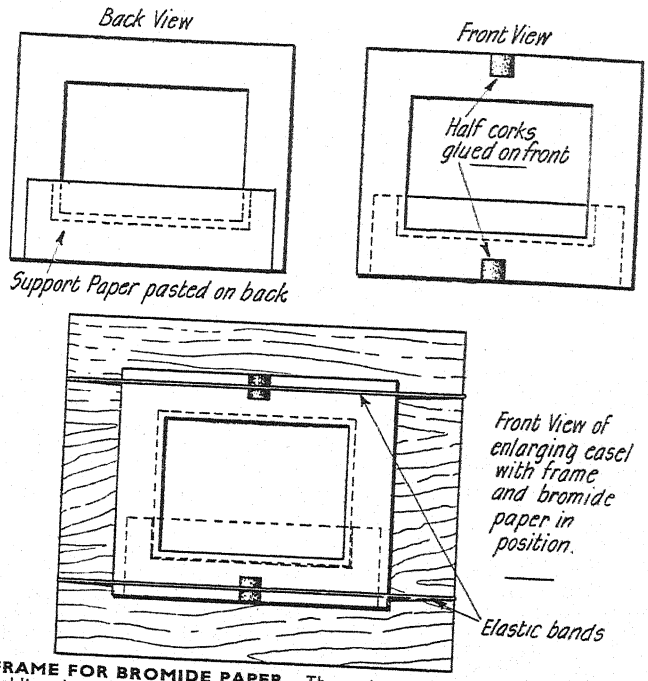
To ensure that there is at least $\frac{1}{8}$ in. clearance

all round, the adhesive may be applied to the back of the frame itself, up to that distance from the edge of the opening, and the backing paper laid down on it and kept under pressure until dry.

Half corks stuck on the front of the frame enable more pressure to be put on by means of elastic bands, as the frame has a tendency to slip on the easel.

In use, the bromide paper is slipped down the back of the frame into the paper pocket, and pushed down as far as it will go. If the $\frac{1}{8}$-in. clearance is quite free the paper will fit in quite square and snug. This gives three uniform borders, with the top overlapping by an equal amount. The frame is then placed on the easel and clamped down by the elastic bands. It can be shifted at will to suit the desired part of the enlargement as projected.

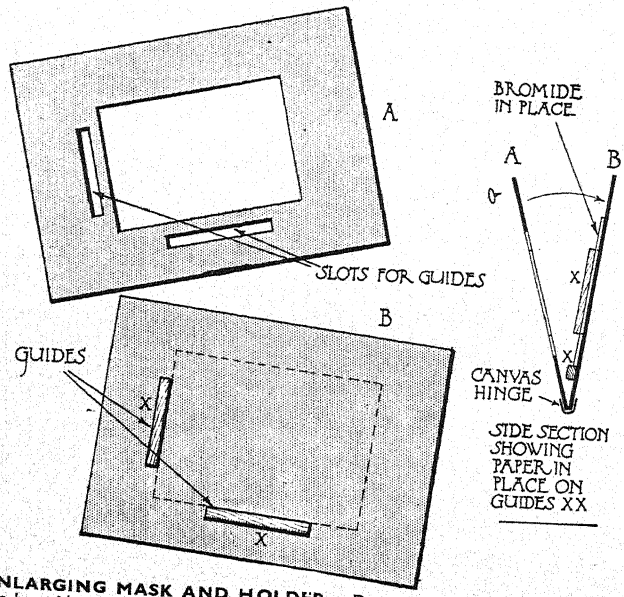
The frame can also be used for vertical enlargers by substituting two small weights for the elastic bands.—*F. WHEELHOUSE.*



FRAME FOR BROMIDE PAPER. Three views of a cardboard frame for holding the paper on the easel used in conjunction with a horizontal enlarger. The bromide paper is fixed in position with elastic bands and located by a paper support

Efficient Enlarging Mask and Paper-Holder. A number of ideas for providing a mask to an enlargement have appeared from time to time, but in most of them it is necessary to adjust the paper in the frame by visual means in order that the mask shall be true. With such a mask one never knows for certain whether the paper has slipped slightly after the hand is removed, giving an uneven border which necessitates trimming to make square again.

With the mask here described the paper could be put in with the eyes shut without risk that the resulting white border would be untrue. It is made from two pieces of stout card of exactly the same size, the measurements depending on the size of enlargement to be made. On one piece is drawn a rectangle of exactly the size of the paper to be used. Inside this a slightly smaller rectangle is drawn, the difference in size being the width of the white margin desired. This smaller rectangle is then cut out with a very sharp knife, as shown at A. Two long, narrow slots are next cut, and here it is essential to exercise great care, or the mask will not be square.

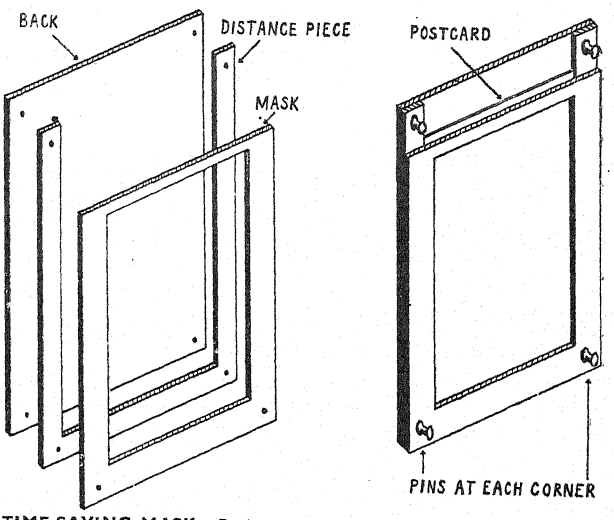


ENLARGING MASK AND HOLDER. Device for holding and masking the bromide paper. It can be used with both vertical and horizontal enlargers

The length and width of these slots is immaterial, but it is absolutely necessary that the inner edge of each should be on the line marked out for the paper size as shown in the sketch.

Now place this piece of card squarely on the second piece, making certain that all the outside edges are perfectly flush. With a sharp pencil mark the position of the slots. Next cut two strips of thick cardboard or wood, slightly shorter and narrower than the two slots, and prepare one edge of each so that it is perfectly straight. These are the guides, X X, which are glued to the baseboard, straight edge inward, in the positions already marked, taking great care that they are square. When the glue is dry the mask is placed on the baseboard, and the two are bound along the bottom edge with a piece of linen to act as a hinge.

With a horizontal enlarger the base is pinned to the easel in roughly the desired position, and, with a vertical enlarger, it is secured by drawing-pins to the baseboard of the enlarger. To use, it is only necessary to open the mask as in the illustration, place the sheet of paper on the bottom runner, and slide it along until it reaches the runner at the side, when it can go no farther. The mask is then shut, held closed by a push-pin, and the enlargement made in the ordinary way. So long as the two runners and their slots have been accurately placed, an even white border will result every time.

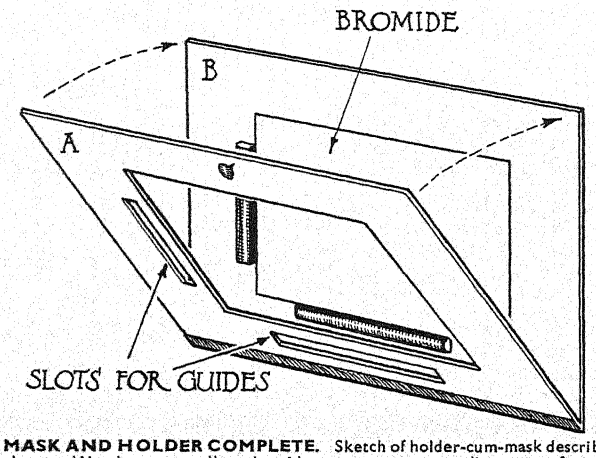


TIME-SAVING MASK. Easily constructed paper holder made of three pieces of cardboard glued together. The holder embodies a mask which gives a neat border to the prints. The device is particularly suitable for pictures of postcard size

If several sizes of paper are to be used, a mask must be made for each ; they can be made at the rate of two an hour. Sizes over whole-plate should be made in wood for rigidity.—*L. GORDON PAULE.*

Simple Holder for Bromide Paper. Probably seventy-five per cent. of the enlargements turned out by most amateurs are made on the smaller sizes of paper of about postcard or half-plate size. A great deal of time is wasted in pinning these small sheets to the easel, and each print must afterwards be trimmed to remove the holes made by the pins. The simple holder described here will obviate these troubles and at the same time it has several other advantages.

The holder embodies a mask which gives the prints a white margin all round, minimizing waste and ensuring a neat finish. It can be moved instantly to any position on the easel so that any desired part of the picture can be selected for enlarging. This is a great advantage and avoids the need for rulings on the easel. Such rulings are of little use with the simpler types of enlarger where the negative carrier is not provided with centring adjustments.



MASK AND HOLDER COMPLETE. Sketch of holder-cum-mask described above. Wooden or cardboard guides ensure correct alinement of paper

It will be seen from the drawings in page 671 that the holder is made from three pieces of cardboard glued together and pinned at each corner. The back is best made from a thick piece of mounting board with a smooth white surface, so that it can be used for focussing upon. It should be about ½ in. larger all round than the enlarging paper or postcard. A suitable size for postcards would be 6½ × 4½ in.

The distance-piece which holds the cards in position should be the same size as the back, and about twice as thick as a postcard. It must be cut away to a U-shape as shown in the drawings. The exact size of the part to be cut away can be got by tracing round a postcard (or other size of enlarging paper). The margin at the foot can be about ⅜ in., and around the sides about ½ in.

Any piece of good smooth card can be used for the mask. It should be the same width as the other pieces, and about ⅜ in. shorter. A rectangle is cut away from the centre, leaving a sufficient margin all round to give the prints a white border of ⅛ to ¼ in. in width. The top margin of the mask should be about ¼ in. in width and arranged to allow the prints to project about ⅛ in., so that they can be easily withdrawn.

After gluing the three pieces together, push-pins are inserted at each corner and glued in position, leaving the points projecting about ⅛ in. at the back. This allows the holder to be fixed in any position by merely pressing it against the easel.

A neat finish can be given by painting the mask black. This also allows one to see at a glance the exact size of the printing paper.—*A. HARCUS CUTT.*

An Enlarger Focussing Hint. For securing critical focussing in the enlarger the use of a ruled screen in place of the negative has often been recommended, but as this necessitates a double change-over, it is probably neglected by a good many amateurs. A strip of glass let permanently into the side of the enlarger carrier, however, offers the advantages of this method without the extra trouble otherwise entailed.

By pushing the carrier a little farther into the enlarger, the ruled strip is brought into view on the screen, and all one has to do in order to be able to " replace " the negative is to pull the carrier back once more into the position which it originally occupied.

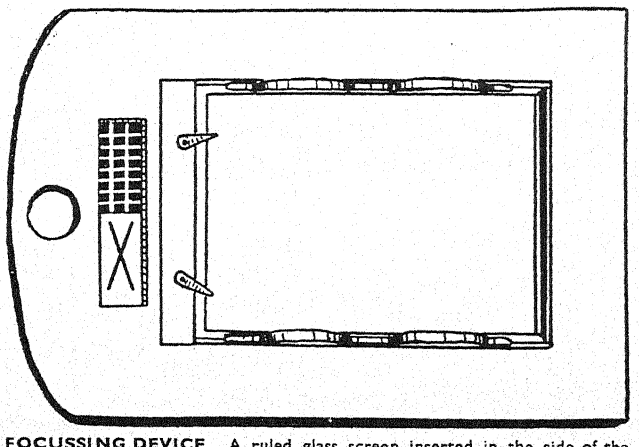
A strip about 2 × ½ in. is a convenient size for a ¼-plate carrier. Cut the glass first and use this as a template for marking the hole, and then a tight fit will be assured. For focussing, either clear lines on a black ground or black lines on a clear ground will serve equally well. In the strip illustrated a choice of either was made possible by covering half with black paper and scoring it through with a knife when dry, and by sticking two pieces of black cotton on to the remaining clear half.

To ensure the strip being a really accurate guide, it must, of course, be fixed so that the black paper and the cotton are in exactly the same plane as the film side of the negative, and care must be taken always to put the negatives in the carrier the same way round.—*LESLIE W. BOLTON.*

A Gadget for the Vertical Enlarger. The correction of tilted verticals is a simple matter when a horizontal enlarger is used, as the easel is generally made to swing. With a vertical enlarger, however, the baseboard is fixed and is incapable of being tilted to correct the convergence of the vertical lines in the negative.

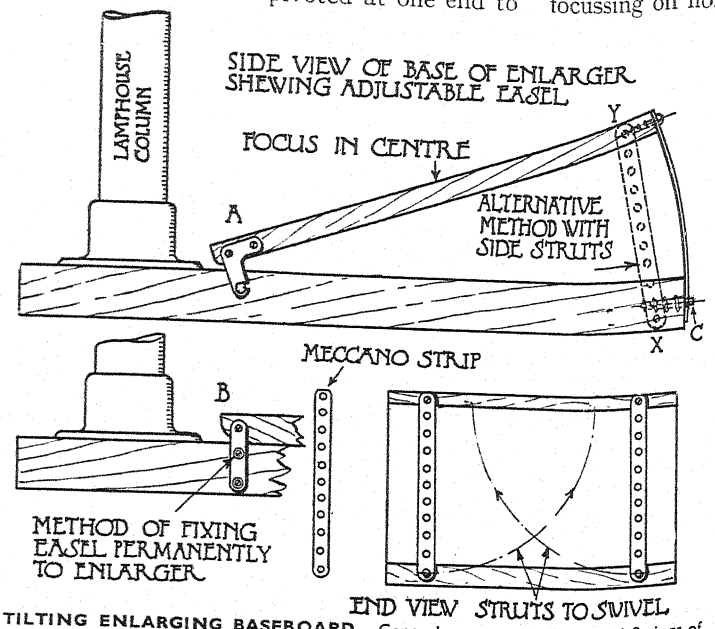
It is, however, an easy matter to make a detachable (or permanent) tilting baseboard, and the cost and labour involved are slight.

A half-imperial drawing-board, planed to the correct size, or a piece of " block board " (a sort of thick plywood) obtained from a



FOCUSSING DEVICE. A ruled glass screen inserted in the side of the enlarger carrier provides a rapid and accurate means of focussing

cabinet-maker for a shilling or so, the width of the enlarger baseboard, forms the easel. Two perforated strips of metal are fixed to the enlarger baseboard by means of ordinary screws and the board pivoted at one end to the top of these metal pieces by means of two more screws (as at B). For automatic focussing enlargers the easel must be detachable, and the metal strip should have a slotted hole and be attached to the easel as at A.



TILTING ENLARGING BASEBOARD. General arrangement and detail fittings of a simply constructed tilting baseboard for use with vertical enlargers. The device is used for correcting the convergence of vertical lines in a negative

This tilting baseboard may be propped up with books to the desired slope, but a better way is to fix two perforated strips to the edge of the easel with screws. Two screws, C, are driven into the baseboard and their heads cut off, to form pegs. The holes in the strips will engage with these pegs, holding the easel in position.

If more convenient the strips may be fixed to the baseboard and the pegs in the easel. The strips may be rotated flat when not in use. It is perhaps needless to add that focussing arrangements are upset when any tilting takes place, and it is necessary to stop down after focussing on the centre of the image in order to increase the depth of focus and render the whole sharp.—*A. T. BAILEY.*

An Aid to Accurate Enlarger Focussing. In order to make perfect enlargements the focussing must be carried out accurately.

The device described here gives accurate focussing on horizontal enlargers.

A small section, say about $3\frac{1}{2} \times 2\frac{1}{2}$ in., must be cut out of the centre of the focussing easel of the enlarger.

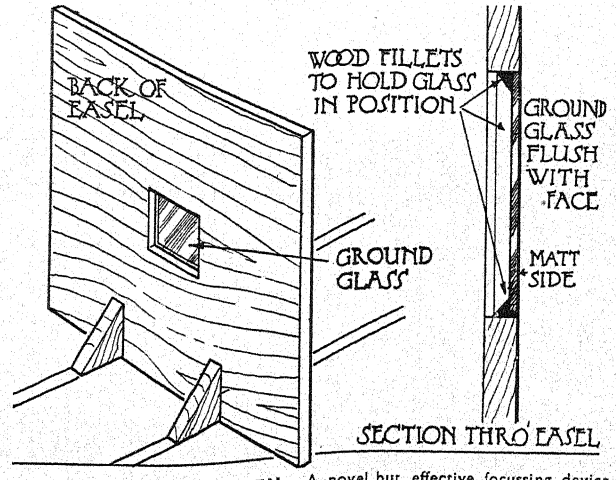
In this is placed a piece of ground glass of the same size and fastened in place so that the matt surface of the glass is flush with the side on which the bromide paper is pinned.

The focussing is carried out in the usual way on the white surface of the easel, and in order to ascertain whether the image is dead sharp it is viewed on the ground glass in the same way as a focussing screen of a plate camera—that is, the image is viewed from the back of the easel.

The ground glass can be effectively held in place by fixing a framework of wood.

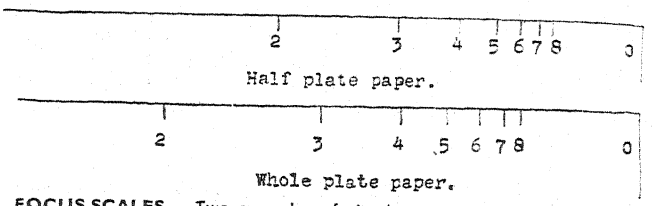
If a strong glue is applied to the framework and the glass pressed tightly against it, it will hold in place quite well.

L. G. CHILMAN.



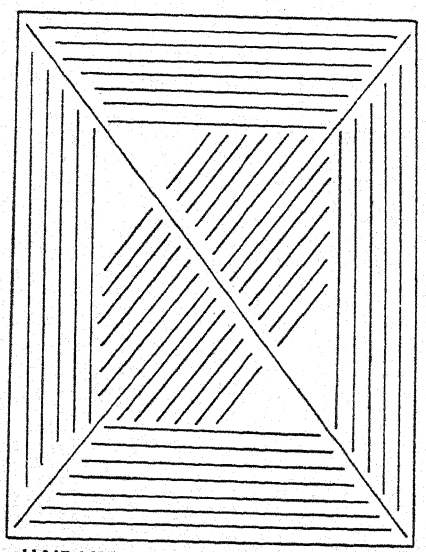
EASEL FOCUSSING SCREEN. A novel but effective focussing device described in this page

Hair-Line Focussing. This method employs actual hairs. After soaking an old glass negative in hot water for a few minutes, remove the emulsion with a safety-razor blade and a piece of clean cloth. After drying, apply a coat of clear, liquid gum to one side and place lengths of human hair in various positions on the gum as shown in sketch below. Then put the screen away for a few days in a horizontal position to get thoroughly dry and hard.



FOCUS SCALES. Two examples of simple means for estimating the degree of enlargement which is required to bring any picture up to any of the standard paper sizes

Roughly focus the negative on the easel, remove it from the carrier, and replace with the screen in the same position and facing the same way. If the negative is on a glass plate, it is only necessary to put the focussing screen into the carrier so that the side bearing the hair takes the place of the emulsion side of the negative. If, however, the enlargement is being made from a film, some care is necessary. To remove the film, together with the two pieces of glass between which it is sandwiched, and to put the screen in the place of the whole is not correct, for this will put the hairs at a different distance from the lens than was the image. The film must be removed, together with the sheet of glass next its back (shiny side), and the screen must be placed in the carrier with the hair side resting on the glass which previously supported the front (dull side) of the film.



HAIR-LINE FOCUSSING. A focussing screen constructed from an old glass negative. After removal of the emulsion the glass is treated with gum and lengths of hair are fixed on the surface in the pattern shown

Now carefully focus and adjust the carrier or easel until the hairs are clearly defined over the whole of the enlarging area. After replacing the screen with the negative, make the exposure in the usual way. The enlargement will then show all the fine detail contained in the negative.—*C. M. CROSBY.*

Enlarging Focus Scales. Many semi-automatic enlargers on the market are fitted with duplicate scales showing the degree of enlargement, pointers on the lens mount and lantern being set to the same figure to ensure sharpness of focus. Unless the degree of enlargement required is known, this system necessitates either a certain amount of trial and error work with the enlarger itself, or preliminary measurements on the negative and subsequent arithmetical calculations.

If a series of scales is made according to the design shown above, the degree of enlargement necessary to bring any picture up to any of the standard paper sizes may be read off directly from a contact print using the appropriate scale. Each scale is made on cardboard named with a standard size of paper, *e.g.* whole-plate, but the points on it are marked with enlarging ratios instead of inches. Thus, since whole-plate paper is $8\frac{1}{2}$ in. long, the point $4\frac{1}{4}$ in. from the zero is marked $\times 2$, the point 2.83 in. from the zero (*i.e.* one-third of $8\frac{1}{2}$ in.) is $\times 3$, and so on. Similar scales are made for other standard sizes of paper as required.

To use the scales, contact prints from the negatives to be used in the enlarger are needed. A print is taken and masked in the usual way with L-shaped pieces of card until the required picture is isolated. If this is to be printed, say, half-plate size, the scale marked "half-plate" is used in order to measure the length of the picture which is enclosed by the masks, and instead of obtaining the actual length in inches, the degree of enlargement which is required is read off directly.

A certain amount of experienced judgement is required to ensure that the picture will not be too wide for the paper chosen, or a set of scales may easily be made to measure the width magnification as well as that for the length. It is then merely necessary to see that the width enlargement is not greater than the length. Otherwise a larger sheet of paper must be chosen and masked. Photographers who habitually mask their prints will obviously need to rule their scales to fit the slightly reduced dimensions of the space available for printing.—*M. L. HASELGROVE.*

ENLARGING: (10) PRINTS FROM CINE FRAMES

Here are described the methods available for making satisfactory enlargements from sub-standard cine frames. If the instructions of the author, Mr. Stanley W. Bowler, A.R.P.S., are adhered to, the amateur will experience little difficulty

There are three possible types of film from which it may be required to produce enlargements : (1) negative ; (2) reversal ; and (3) colour. Each of the three differs slightly in the particular methods which may be adopted, but generally the requirements for the work are the same. The frame selected should show little or no movement wherever possible, should be sharp, and should not contain too great an amount of detail, *i.e.* a close-up would be preferable to a long-shot. The apparatus upon which the enlargements are to be made should have a first-class optical system, *i.e.* comparable with, say, a miniature enlarger such as is used for enlarging 35-mm. size negatives. Special attachments are available also for converting projectors into enlargers, but these are usually of the fixed-focus pattern.

Enlarging from Negative Film. Provided that the negative has been carefully processed, it should be possible to obtain enlargements direct up to half-plate size, and on rough paper the grain should not be unduly apparent. Where enlargements bigger than this are required, it is usually considered better to prepare an intermediate negative. This may be most simply done by the use of the Agfa Direct Duplicate film (*see* Duplicate Film : Agfa), which produces a negative direct from a negative in one process. Care should be exercised to avoid building up excessive contrast—ample exposure will ensure this. The production of this negative, either by the method suggested or by means of an intermediate soft duplicate positive contact printed on to a new negative, enables retouching to be carried out, so that a number of repetition enlargements may be made.

Enlarging from Reversal Film. With reversal originals, an intermediate negative is an essential. (A transparency, however, may be made in one operation again by the use of the Agfa Direct Duplicate film.) With the commercial form of projector adapter mentioned the usual size of enlarged negative is $3\frac{1}{2} \times 2\frac{1}{2}$ in.—this is rather small, and quarter-plate would be preferable in view of the greater area and ease of retouching before printing from it. Suitable material for the intermediate negative required is ordinary non-colour sensitive plate or film—the " ordinary " plate or film with an H. & D. rating of approximately 70 to 100. Slow speed orthochromatic material also is suitable and will help to prevent excessive contrast. With the first-mentioned material the developer should be either dilute or one of the M.Q. borax fine-grain type. The exposure should be full and development prolonged.

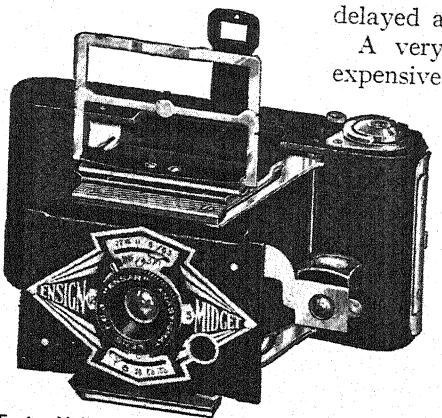
Enlarging from Colour Film. As all the popular colour films work on some form of the reversal process, an intermediate negative is required as for black-and-white reversal film. The material to be used for the intermediate negative must, however, be colour sensitive to preserve a correct balance of the original tones when rendered in monochrome. For this purpose a slow-speed panchromatic material should be selected.

Prints in Colour from Cine Film. For this purpose it is usually best to prepare a set of three-colour-separation negatives. These can be made through a series of special three-colour filters on to suitable panchromatic plates or films. Care should be taken to avoid moving the enlarging device between each negative, and some experience is required in maintaining the correct balance between the three negatives. The Carbro process (*see under* Colour Photography, Trichrome Carbro) may be used for making the prints from the set of three-colour negatives. This work should not be attempted until proficiency has been attained in making ordinary black - and - white enlargements along the lines suggested.

ENSIGN, LTD. This all-British firm has for many years enjoyed a high reputation for photographic apparatus and accessories, the range of which is too extensive to permit the mention here of more than a few outstanding products.

Among the box-form roll-film cameras made by Ensign, Ltd., the "All-Distance-20," for pictures $2\frac{1}{4} \times 3\frac{1}{4}$ in., is remarkably good value at the low price of 15s., incorporating as it does a colour-filter built into the diaphragm mechanism.

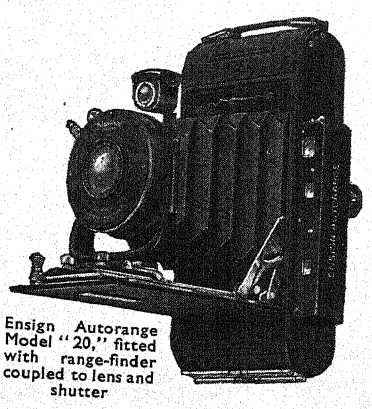
The Ensign E-20, a very popular box camera, takes pictures either $2\frac{1}{4} \times 3\frac{1}{4}$ in. or $2\frac{1}{4} \times 1\frac{5}{8}$ in., a film mask for the latter size being housed inside the camera, and the view-finders are outlined to show the amount of picture included when the smaller size is being used. The shutter is provided with time and instantaneous movement and a special device prevents double exposure. The lens is the Ensign All-Distance, taking pictures at any distance from 6 feet upwards. The hinged back is provided with two red windows and pressure plate.



Ensign Midget Model "55," equipped with f6.3 Ensar anastigmat lens. The camera measures only $3\frac{1}{2} \times \frac{5}{8} \times 1\frac{3}{4}$ in., and takes 3 × 4 cm. pictures

The "Selfix-220" is also of the standard folding type, taking either 12 pictures $2\frac{1}{4} \times 2\frac{1}{4}$ in., or 16 pictures $2\frac{1}{4} \times 1\frac{5}{8}$ in. on size 20 film. External parts are finished in lustre or polished chromium. This camera is fitted with an ingenious exposure counter for either 12 or 16 pictures, the two scales being engraved on each side of a reversible plate. The focussing scale is combined with a depth of focus scale, and the focussing lever automatically returns to infinity when the camera is closed. The "Selfix-220" can be had with various lenses and shutters.

For those who appreciate the advantages of a coupled range-finder, the Ensign "Autorange-20" is an ideal quick-action camera.


Ensign Autorange Model "20," fitted with range-finder coupled to lens and shutter

The specification of this camera resembles that of the "Selfix-220" in its main features, with the addition of a coincidence type range-finder coupled to the focussing mechanism. The eye-piece is adjustable for variations of eyesight. The "Autorange-20" can be obtained in a variety of lenses and shutters, according to price, varying from an Ensar *f*4.5 anastigmat in Trichro shutter to a Zeiss Tessar *f*3.8 in Compur rapid shutter speeded from 1 sec. to 1/400 sec., with delayed action.

A very popular and inexpensive camera taking pictures 3 × 4 cm. is the Ensign "Midget," a true vest-pocket camera, measuring only $3\frac{1}{2} \times \frac{5}{8} \times 1\frac{3}{4}$ in. The Model 22 has an all-distance lens and a self-setting time and snapshot shutter. Model 33 has an all-distance lens, and Model 55 an Ensar *f*6.3 anastigmat, both in 3-speed shutters.

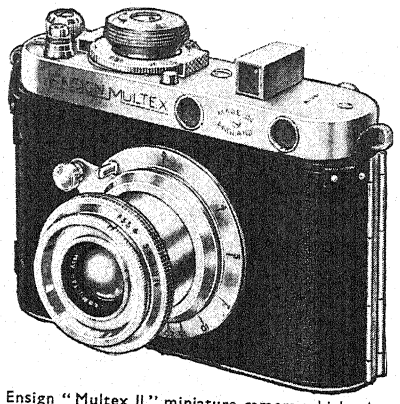
The Ensign "Multex II" is a precision miniature camera taking 14 pictures 3 × 4 cm. on standard size 27 or 127 spool. The greater part of the metalwork of this camera is made of aluminium and hiduminium alloys, so that, in spite of the complex mechanism, the instrument weighs only 23 ozs. The coupled range-finder focusses down to 21 inches, and the direct-vision optical view-finder is fitted centrally over the range-finder.

Double exposure is impossible, the film-winding mechanism being coupled to the shutter and the film automatically wound before the shutter is set. The focal plane shutter has a wide range of speeds: 1 sec., 1/2, 1/10, 1/15, 1/25, 1/50, 1/75, 1/100, 1/150, 1/250, 1/500, 1/1000, and time. The shutter release knob is placed very conveniently on top of the camera and the boss is threaded to take a flexible release if so desired.

The lens provided is an Ensign Multar *f*3.5, but Ross and Zeiss lenses are also available. The diaphragm is adjustable by rotating a milled flange on the front cell,

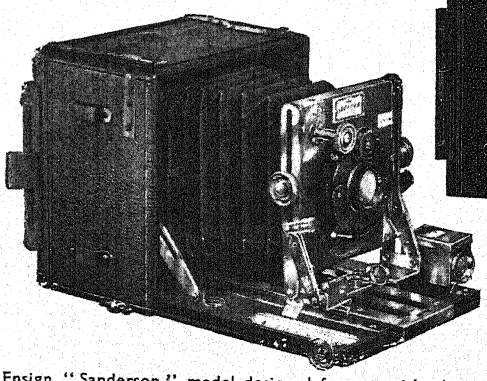
while the range-finder, which is coupled to the lens, is operated by a small lever on the lens mount.

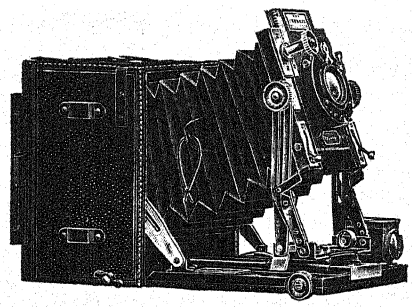
A type of camera much favoured by serious pictorial workers is the Ensign "Sanderson," a quarter-plate hand or stand camera for plates, film-packs and cut film. It is provided with a long extension, operated by rack and pinion, revolving back, universal swing front, and an arrangement for using wide-angle lenses. The body is of leather-covered mahogany, and all metal parts are nickel-plated.



Ensign "Multex II" miniature camera which takes 3 × 4 cm. pictures. The instrument has a Multar f3.5 lens and self-capping focal plane shutter

The "Zeca-Flex," distributed in this Country by Ensign, Ltd., is a high-class folding roll-film camera with a reflex arrangement, and really belongs to the class of twin-lens reflexes taking 12 $2\frac{1}{4} \times 2\frac{1}{4}$ in. pictures on a standard 20 spool. Although the camera folds, the reflex attachment





Ensign "Sanderson" model designed for use with plates, film-packs or cut films ($4\frac{1}{4} \times 3\frac{1}{4}$ in.). Right, the camera with front raised, bringing lens level with upper edge of plate

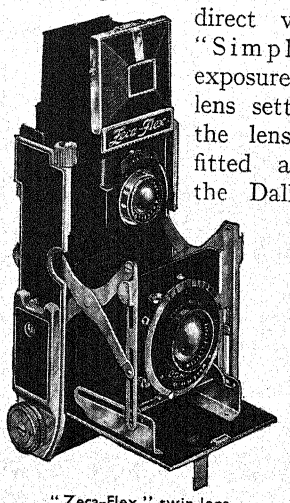
does not, but compactness has been achieved by making the finder lens of shorter focal length than that of the taking lens. This means, of course, that the picture on the focussing screen is smaller than the actual picture on the film.

After the lens panel has been drawn forward and locked into position, focussing is performed by rotating a small knob to the right of the view-finder. This, acting by a micrometer thread on the lazy-tongs, moves the front of the camera forward, and at the same time operates the focussing mount of the finder lens.

The "Zeca-Flex" is fitted with a Compur Rapid shutter giving a range of speeds from 1 to 1/400 sec., and is provided with delayed action. Either a Schneider Xenar *f*3.5 or a Zeiss Tessar of the same aperture is fitted.

Cine Cameras. The Ensign "Simplex Pockette" is a compact 16-mm. cine camera which fits comfortably into the pocket. The size is $1\frac{3}{8} \times 4\frac{3}{4} \times 5\frac{1}{2}$ in., and the weight 35 ozs.

No threading of the film is necessary when loading. The special charger, carrying 50 feet of film, is merely pushed into its recess and it engages automatically with the film-moving mechanism. There are two speeds, 16 and 12 frames per second, a footage counter is incorporated, and a dial control stops the motor automatically at a predetermined footage. There are both waist-level and direct vision-finders on the "Simplex-Pockette"; an exposure guide giving correct lens settings is found under the lens itself. The lenses fitted are the Ensar *f*3.5, the Dallmeyer *f*2.9, or the Ross *f*1.9.



"Zeca-Flex" twin-lens reflex camera

Ensign "Kinecam" 16-mm. cine cameras take 50 feet or 100 feet of film. A double spring clockwork takes 30 feet of film without rewinding. A hand turn movement is reversible for "dissolves."

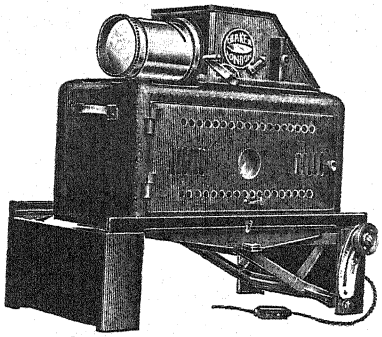
A direct view-finder on the lid in the direct axis of the lens enables accurate centring to be obtained for very close-up shots down to 1 foot from the camera. An enclosed view-finder is also fitted. A sliding scale back-sight provides correction for parallax.

The Ensign "Super-Kinecam" Model 8 has a triple revolving turret head, capable of taking three lenses of different focus, so that subjects at considerable distances can be taken.

The multi-speed mechanism has five speeds, *i.e.* 8, 12, 16, 32, and 64 pictures per second.

A patent tri-optic synchronizing view-finder, fitted with three separate lens combinations, is fitted to the side of the camera, enabling a correct view to be obtained in the exact size in which it will appear in the film, whichever lens is being used on the turret; thus the full amount of magnification is easily discernible in each instance.

Projectors. The Ensign 16-mm. "Silent Sixteen" projector is permanently fixed in a strong but light case. By one movement both reel arms are brought into position. The mechanism is mounted in die-cast housings, and is silent in operation. It embodies positive claw and patent flickerless barrel type shutter, ensuring rock-steady projection. The optical equipment is designed as one unit, with special 2-inch *f*1.8 Dallmeyer "Superlite" projection lens in hinged mount. "Quick-thread" focussing.

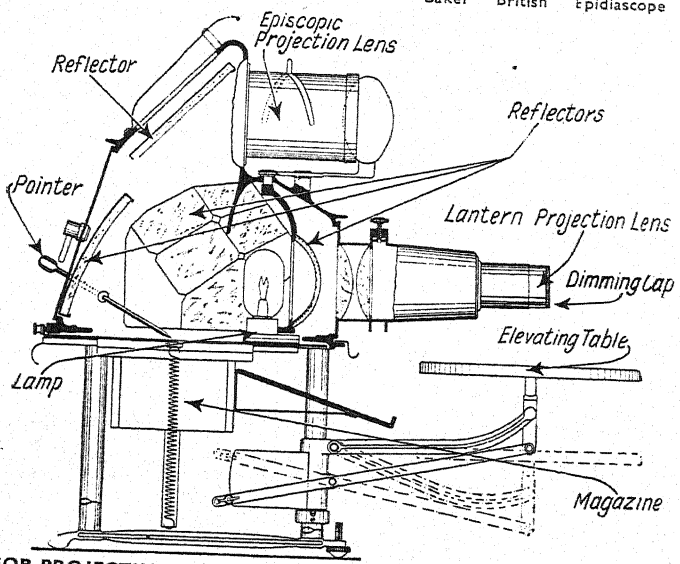


Baker "British" Epidiascope

The framing device centres the picture on the screen by the movement of a lever.

The driving unit is mounted in a separate section with the lamp, and embodies a silent-running fan.

A still picture can be shown. For Ensign enlargers *see under* Enlargers.



FOR PROJECTING OBJECTS. Aldis Epidiascope shown in part section. The apparatus gives a circular projection of up to 12 ft. 2 in. diameter

EPIDIASCOPE. This apparatus, also called an Episcope, is a lantern for projecting an enlarged image of opaque objects, such as postcards, prints, coins, etc., on any flat surface or screen by means of reflected light. A system of mirrors or prisms is employed in conjunction with a lens for projecting the image, which must be brightly and evenly illuminated, on to the screen.

The illuminant is situated very near to the back of the projection lens mount, so as to give maximum front lighting on the subject, which must be at right angles to the lens axis.

The lens must, naturally, be one of large aperture, to compensate for the loss of light by reflection, since with a normal lantern slide projector the light is transmitted through the positive, so that no great loss of light occurs. Focussing is carried out by varying the distance of the lens and object, and lens and screen.

The accompanying diagram shows the working principles of the Epidiascope as embodied in the Aldis Epidiascope.

END OF VOLUME

CENTRAL ARCHAEOLOGICAL LIBRARY New Delhi